

RADIOLOGY

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RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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Angiocardiography in the Preoperative Diagnosis of Mitral Stenosis and Insufficiency¹

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ALTHOUGH THE surgical correction of mitral stenosis has become firmly established and more widely used, the surgery of mitral regurgitation has remained largely experimental. In the preoperative evaluation of patients, therefore, the accurate differentiation of stenosis from insufficiency is still of the utmost importance. Unfortunately, the ordinary methods of routine clinical examination and roentgenography fail to detect some cases of mitral insufficiency. In present mitral commissurotomy series, the frequency of "pure" stenosis *versus* "pure" insufficiency is about 20 to 1. Thus, in the first 150 commissurotomies performed at The Johns Hopkins Hospital, 80 per cent of the patients were found at surgery to have "pure" stenosis, 4 per cent "pure" insufficiency, 4 per cent equal stenosis and insufficiency, and 12 per cent predominant stenosis with minor insufficiency (8). The pathological incidence of stenosis is so much greater than that of insufficiency that the percentage of fruitless surgical procedures is quite small. Therefore, in evaluating any new preoperative diagnostic procedure, the total number of accurate diagnoses in a series means very little. It is the accuracy of selection of the few

cases of regurgitation which must be judged.

Angiocardiography has been used in mitral rheumatic heart disease for more than fifteen years, but it has been utilized in the differentiation of stenosis from insufficiency only recently. The limited literature on the subject will be briefly reviewed, and the results of angiocardiography in 32 surgically proved cases will be presented.

ANATOMICAL ABNORMALITIES DEMONSTRATED BY ANGIOCARDIOGRAPHY

The initial angiocardiographic studies in mitral valvular disease (6, 9), prior to the days of surgery, were devoted chiefly to the clarification of the cardiac silhouette as seen on plain chest roentgenograms and fluoroscopy. The enlargement of the left atrium, left auricular appendage, and right ventricle was demonstrated. When the right ventricle was definitely enlarged, an increased thickness of the right ventricular wall due to hypertrophy and a displacement of the interventricular septum to the left were seen. It was clearly shown that the conus arteriosus or outflow tract of the right ventricle was not usually border-forming in the frontal projection. The

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prominences in the left upper cardiac contour were entirely due to the dilated main and left pulmonary artery above, and the enlarged left auricular appendage below. In their report of 6 cases of mitral valvular disease, Robb and Steinberg (9) noted also an abnormal dilatation of the pulmonary veins, which they believed played a significant role in the elevation of the left main bronchus in cases with marked left atrial enlargement. They observed that the inflow tract of the right ventricle was often "honeycombed," presumably due to hypertrophy of the trabeculae carneae. They pointed out, also, that the right atrium was usually not enlarged in the absence of auricular fibrillation or heart failure. Grishman, Sussman, and Steinberg (6) reported the angiocardigraphic findings in 21 cases of mitral valvular disease and 5 cases of combined aortic and mitral disease. Four of their patients had "giant" left atria, which on one occasion formed the entire right cardiac border and in another case made up the entire left border. They emphasized that dilatation of the main pulmonary artery was usually not marked.

Dotter and Steinberg (3) observed that the amount of left atrial enlargement could be evaluated on the early lateral films by the degree of impression on the right atrium. The fullness of the anterior heart border in the lateral view, they pointed out, was caused as much by displacement of the right ventricle by the left atrium as by actual enlargement of the right ventricle. They successfully demonstrated a thrombus of the left auricular appendage by angiocardigraphy in a patient with repeated embolic episodes; this finding was verified at surgery. Other authors (2, 10), however, have failed to visualize thrombi subsequently found at operation.

There has been disagreement in the literature as to whether mitral stenosis or regurgitation produces the greater degree of left atrial enlargement. Some authors have claimed that insufficiency generally produces only mild to moderate degrees of enlargement (2, 6) and that "giant"

left atria are almost always the result of stenosis. Others, however, have found "giant" left atria nearly always associated with significant regurgitation (10, 13). Zinsser and Johnson (13) thought that the size of the left atrium alone was of little help in distinguishing stenosis from regurgitation.

The only anatomical abnormalities considered by most writers to be of definite aid in differentiating mitral stenosis from insufficiency have been dilatation and hypertrophy of the left ventricle in cases of insufficiency.

ALTERED HEMODYNAMICS DEMONSTRATED BY ANGIOCARDIOGRAPHY

In a normal adult angiocardigram, the entire period of opacification of the left chambers and aorta takes place from four to twelve seconds after injection of the contrast medium. Following initial visualization, the peak opacification is reached within two or three seconds, and the period of fading is similarly rapid. In mitral stenosis, however, all authors have noted an abnormally prolonged opacification of the left atrium due to the slow circulation time and the large capacity of the chamber. Slow circulation times have tended to occur in patients with enlarged hearts and with auricular fibrillation (13); some patients with mitral stenosis, however, have had normal circulation times.

Angiocardigraphy has been considered valuable in demonstrating the pulmonary vascular changes (1, 4, 12, 13) secondary to mitral valvular disease. Goodwin, Steiner, and Lowe (4) claimed that the dilatation of the main pulmonary artery and the degree of constriction of the peripheral branches could be correlated roughly with the severity of the pulmonary hypertension and also with clinical disability.

Several authors (1, 2, 11, 13) have observed a different pattern of opacification in mitral stenosis and insufficiency. In stenosis, the left atrium is said to opacify more densely than the left ventricle and, as a result, the line of demarcation between

TABLE I: SUMMARY OF RESULTS OF ANGIOCARDIOGRAPHY IN MITRAL VALVULAR LESIONS

	Surgical Findings	Clinical Diagnosis	Angiocardiographic Diagnosis
Biörck <i>et al.</i> (2)	9 S	5 S, 2 Si, 2 I	8 S, 1 O
17 angiocardigrams	1 Si	1 S	1 S
12 surgically proved	1 sI	1 SI	1 Si
	1 I	1 Si	1 S ? I
Zinsser and Johnson (13)	117 S	60 S, 57 ? I	117 S
150 angiocardigrams	3 S (autopsy)	3 ? I	3 S
123 surgically proved	6 I	6 I	6 S
3 autopsy proved	16 No proof	16 ? I	16 I
	8 No proof	2 S, 6 ? I	8 S
Authors	13 S	9 S, 4 Si	8 S, 2 Si, 3 I
50 angiocardigrams	12 Si	3 S, 7 Si, 2 SI	6 S, 5 Si, 1 I
32 surgically proved	2 SI	1 Si, 1 SI	2 S
	5 I	4 Si, 1 I	2 S, 1 I, 1 O, 1 ? I

S. "Pure" stenosis. I. "Pure" insufficiency. O. Non-informative. Si. Predominant stenosis with minor insufficiency. SI. Equal degree of stenosis and insufficiency. sI. Predominant insufficiency with minor stenosis.

the two remains sharp. In regurgitation, on the other hand, the left atrium and ventricle are said to opacify to a similar density, and the line of demarcation is indistinct or absent. Biörck *et al.* (2) stated that the passage of the medium into the left ventricle appeared to be delayed in stenosis and less delayed in insufficiency. Zinsser and Johnson, however, found no essential difference in the absolute times of opacification of the left atrium, left ventricle, and aorta in stenosis and regurgitation. Furthermore, cases with marked differences in opacification times often were found to have similar degrees of stenosis at surgery. These authors thought that the duration of sharp left atrial contrast, relative to the total cardiac opacification time, was of some significance.

CORRELATION OF ANGIOCARDIOGRAPHIC AND SURGICAL FINDINGS

A comparison of the preoperative angiocardigraphic diagnoses, clinical diagnoses, and the surgical findings in various series is presented in Table I. Actis-Dato *et al.* (1) claimed that the distinction between stenosis and insufficiency in 50 angiocardigrams was good. However, the number of cases verified by surgery and the exact results were not stated.

Biörck *et al.* performed angiocardigraphy in 17 cases, in 12 of which surgery was carried out. In 2 cases in which predom-

inant insufficiency was found at operation, the angiocardigraphic diagnosis had been predominant stenosis in 1 and stenosis with questionable insufficiency in the other. No false diagnoses of insufficiency were made. Biörck and his associates regarded the procedure as of value, especially in problem cases; however, they considered angiocardigraphy to be inferior to both auscultation of the murmurs and routine roentgenography as a diagnostic tool.

Zinsser and Johnson claimed excellent results in their angiocardigraphic diagnoses of 150 mitral valvular cases, of which 123 were proved by surgery and 3 by autopsy without surgery. In 117 cases in which stenosis was found at surgery to predominate, few false angiocardigraphic diagnoses of insufficiency were apparently made. In 1 case, however, there was no difference in the opacification of the two left chambers because of the presence of a large left atrial thrombus. In 5 cases called "stenosis" on the basis of angiocardigrams and verified at surgery, no mitral diastolic murmur was heard preoperatively. In 6 cases showing predominant insufficiency at surgery, the angiocardigraphic diagnosis was stenosis. In 1 of these, the left atrium was huge and the left ventricle could not be identified. In the other 5, the mitral valve orifice was increased in size at surgery and the patients improved postoperatively. The authors suggested that the angiocardigraphic diag-

nosis was more accurate than the surgical findings in this group of 5 cases, and that a "functional" stenosis was actually present.

In the above series, 16 patients had angiocardigraphic signs of insufficiency and, on the basis of this procedure, surgery was not performed. The reliability of the angiocardigraphic criteria of insufficiency was, therefore, not established. Some angiocardigrams were designated as "borderline," but the number of these was not stated. In certain cases with abnormally slow circulation times, poor injections caused faulty diagnoses of insufficiency. The authors considered angiocardigraphy unnecessary in cases diagnosed clinically as "pure" stenosis, but indicated in all cases of questionable insufficiency.

Steiner and Goodwin (10) noted no significant difference in the opacification of the left atrium and ventricle in stenosis and insufficiency, nor any difference in opacification times. They pointed out that even the demonstration of left ventricular enlargement was only suggestive of regurgitation, as it may be due to hypertension or aortic valvular disease.

TECHNIC OF ANGIOCARDIOGRAPHY IN THE PRESENT SERIES

Preliminary circulation times were determined with Decholin diluted with the same volume of saline as the angiocardigraphic medium and injected at the same speed. These showed only a rough correlation with the angiocardigraphic opacification times for the left chambers and aorta. In patients with grossly prolonged circulation times, the end-points of the time intervals were particularly indefinite, but indicated roughly the necessity of wide spacing of the films. In 3 cases, preliminary circulation times were determined with Evans' blue and the use of ear oximeters; excellent curves were obtained with sharp appearance and peak times. The time intervals, however, were greater than the angiocardigraphic opacification times, largely because of the smaller volume of material injected and the more

remote location of the ear compared with the left side of the heart as a recording site.

Fifty cubic centimeters of 70 per cent Urokon were injected rapidly into a superficial antecubital vein, with the usual Robb-Steinberg technic. Simultaneous anteroposterior and lateral films were taken with a Schönander biplane film changer. Two films per second were exposed for the initial four or five seconds for the demonstration of the right chambers. In the majority of the cases, the optimum visualization of the left chambers occurred between ten and twenty seconds after the injection. In 6 patients with a prolongation of the circulation time over twenty seconds, the films of the left chambers were taken at the intervals of ten, fifteen, twenty, thirty, forty, and sixty seconds following injection. In this group, the best visualization occurred between twenty and sixty seconds. In 1 patient there was opacification up to seventy-five seconds.

In a few cases, simultaneous oblique films were taken either in addition to, or in place of, the anteroposterior and lateral films. Although both oblique views were quite satisfactory in demonstrating the chambers, they were not found to offer any particular advantage over the frontal and lateral projections.

Patients with mitral valvular disease in general tolerated the intravenous injection well. There was a fatality, however, in the performance of selective angiocardigraphy on a patient with mitral stenosis, with the tip of the catheter in the pulmonary artery. This case has been described in detail elsewhere (7).

RESULTS OF THE PRESENT STUDY

The authors have performed angiocardigraphy in 50 cases of mitral rheumatic heart disease, but only 32 surgically proved cases will be discussed. Seventeen cases were referred by cardiologists of The Johns Hopkins Hospital, and 15 cases from the Clinic of Surgery, National Heart Institute of the National Institutes of Health. This group of cases differs from

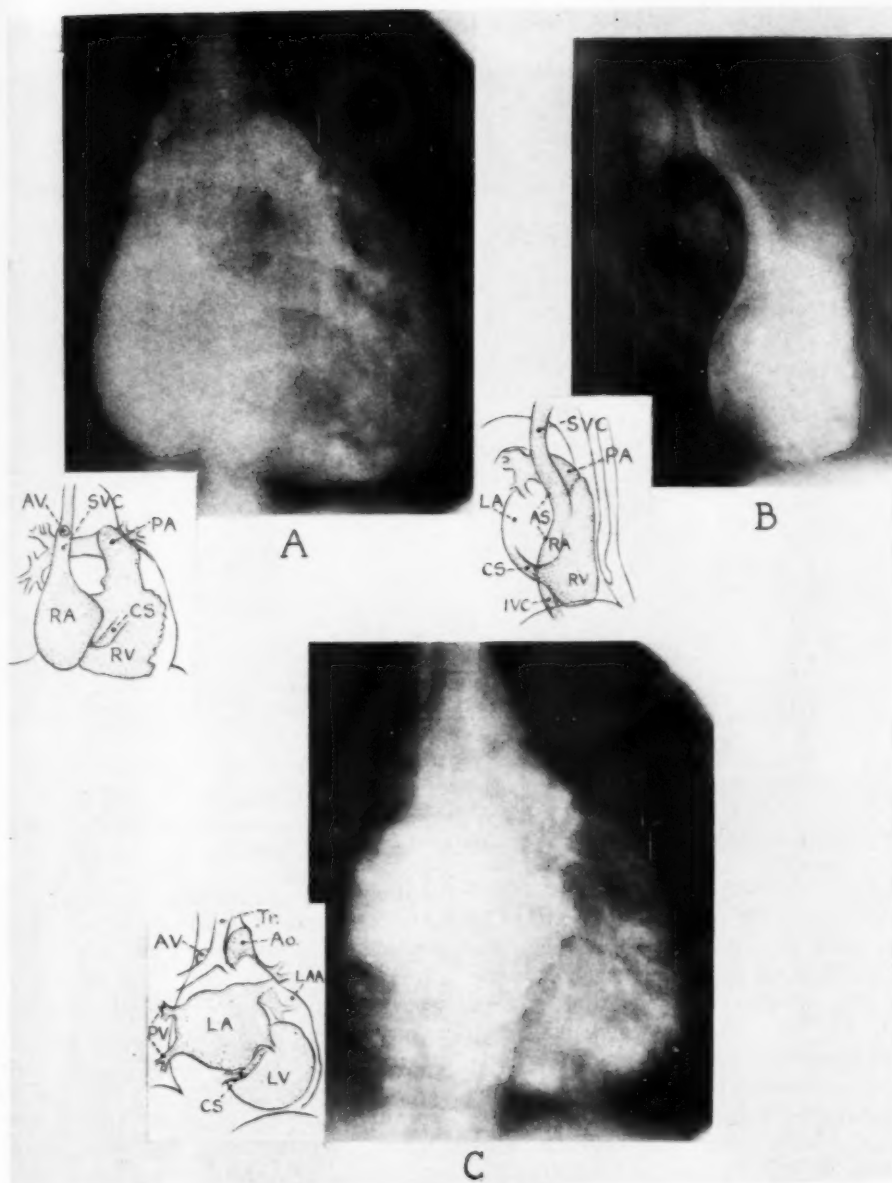


Fig. 1. Severe mitral stenosis at surgery. The angiocardiographic diagnosis was mitral stenosis. A and B. Frontal and lateral films four and a half seconds after injection. The right chambers are enlarged. The superior vena cava, azygos vein, and pulmonary artery are somewhat dilated. Note the moderate anterior bowing of the atrial septum in the lateral view, and the right ventricle closely applied to the sternum anteriorly. C. Frontal film at eleven and a half seconds. The left atrium is dense, and the left ventricle poorly opacified. The large left auricular appendage is not opacified, but no thrombus was found at surgery. Note the retrograde filling of the coronary sinus. Symbols in this and subsequent figures.

RA.	Right atrium	SVC.	Superior vena cava	AV.	Azygos vein
LA.	Left atrium	AS.	Atrial septum	IVC.	Inferior vena cava
PA.	Pulmonary artery	RV.	Right ventricle	LAA.	Left auricular appendage
PV.	Pulmonary veins	LV.	Left ventricle	Tr.	Trachea
		Ao.	Aorta		

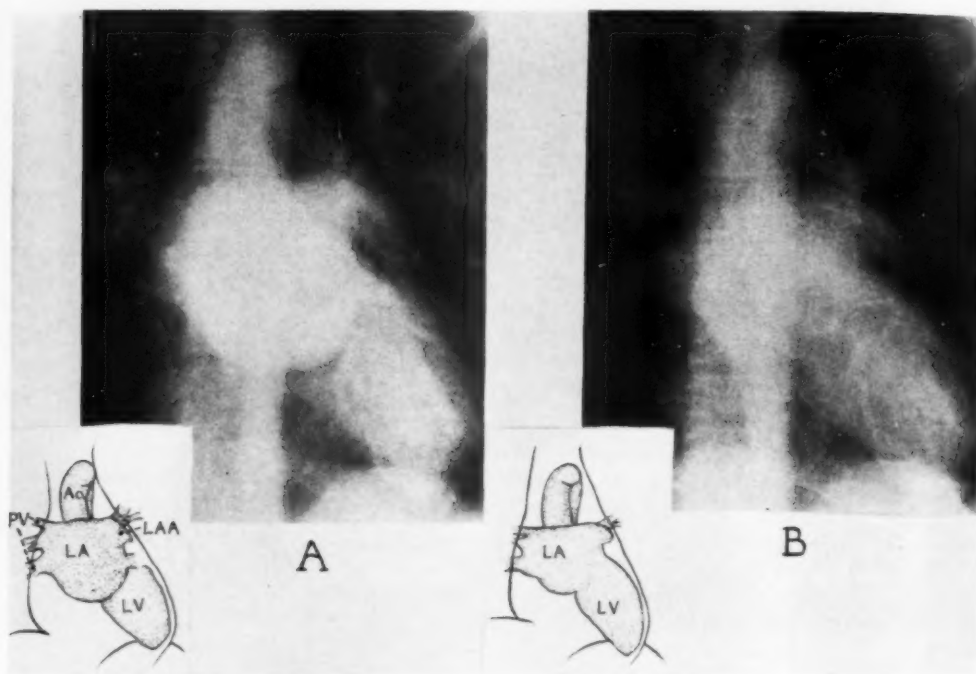


Fig. 2. Moderate mitral stenosis at surgery. The angiocardiographic diagnosis was mitral stenosis.

- A. Frontal projection at ten seconds. The left atrium in diastole is denser than the left ventricle, with a sharp line of demarcation between them. The left auricular appendage and aorta are also well filled.
- B. Frontal projection at thirteen seconds. The left atrium in systole is smaller and less dense than in diastole. The line of demarcation between left atrium and ventricle has disappeared.

other reported series in that the results of angiocardiography were not used as a deterrent to surgery. In only 1 case was there evidence of associated disease of the aortic valve. In compiling the results (Table I), the angiocardiographic and clinical diagnoses were made independently of each other by different observers. Following this, the surgical findings were obtained. The clinical evaluation was based on a combination of the physical, fluoroscopic, and electrocardiographic findings. "Typical" angiocardiograms of mitral stenosis are reproduced in Figures 1 and 2.

For the group as a whole, the angiocardiographic diagnosis was found to be even less reliable than the clinical assessment. In 26 cases of predominant or "pure" stenosis there were only 2 clinical misdiagnoses of equal regurgitation and stenosis. There were, however, 5 false angio-

cardiographic diagnoses of regurgitation (Fig. 3), made on the basis of equal opacification of the left atrium and left ventricle, often without any sharp line of demarcation. Of the 2 cases of equal stenosis and regurgitation seen at surgery, 1 was diagnosed correctly clinically, but neither by angiocardiography. In the 5 cases in which surgery showed "pure" insufficiency, 1 was correctly diagnosed clinically and the other 4 were called "stenosis with minor insufficiency." Angiocardiography afforded a correct diagnosis in 1 case of regurgitation. In another, the diagnosis was suggested on the basis of left ventricular enlargement, although, throughout the examination, this chamber opacified poorly in comparison with the dense left atrium (Fig. 4). Another angiocardiogram in this insufficiency group was non-informative; with a grossly prolonged circulation time and gross cardiomegaly,

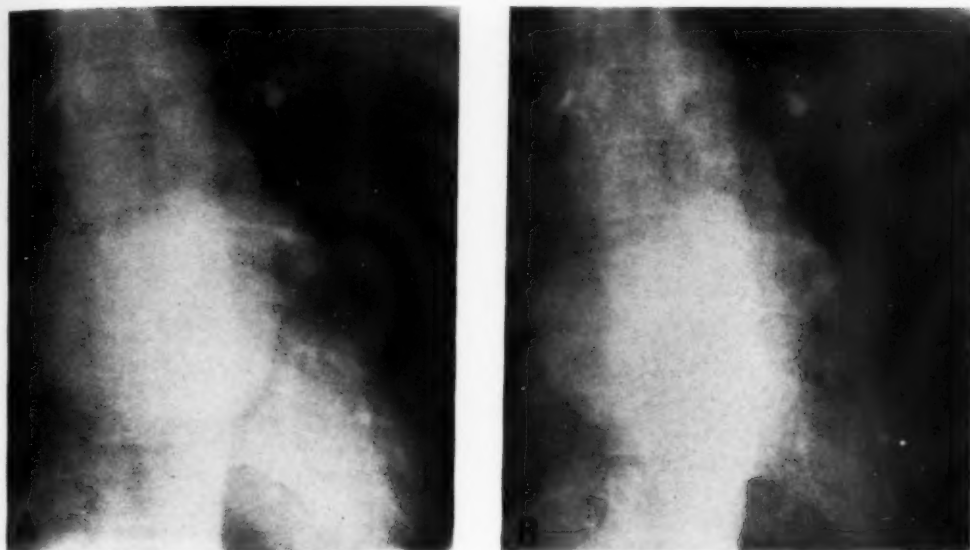


Fig. 3. Severe mitral stenosis with minimal insufficiency at surgery. The angiocardiographic diagnosis was mitral insufficiency.

A. Frontal projection at eleven seconds. The left ventricle in complete diastole has a density similar to that of the left atrium.

B. At twelve seconds. The left ventricle in complete systole is opacified poorly. Note the residual medium in the azygos vein.

the medium was gradually dissipated, resulting in poor delineation of the left chambers. In the 2 remaining cases of proved insufficiency, there were dense filling of the left atrium and faint filling of the small left ventricle (Fig. 5).

One of the most important factors in determining the relative densities of the left atrium and ventricle, and the clearness of the line of demarcation between them, was the phase of the cardiac cycle in which the films were exposed. This factor has been neglected by some workers. With film speeds of two per second, the difference in appearance between systole and diastole is usually demonstrated (Figs. 1 and 2).

When simultaneous films are taken in two planes, it is common for the left atrium and ventricle to have similar densities in one plane and different densities in the other, according to the length of the particular diameter of the cardiac chambers parallel to the x-rays. The times of appearance, maximum density, and fading of opacification of the various

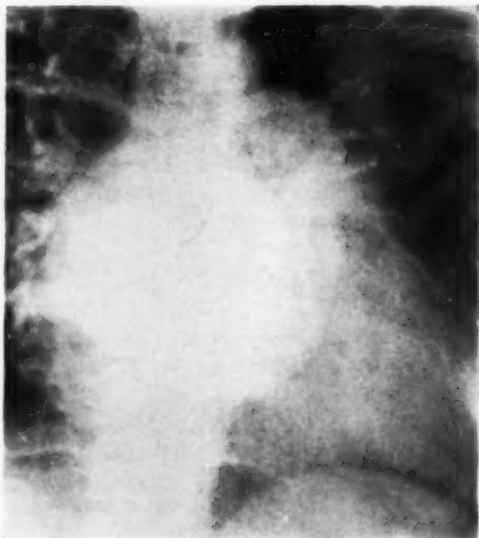


Fig. 4. "Pure" mitral insufficiency at surgery. The angiocardiographic diagnosis was "insufficiency," on the basis of left ventricular enlargement. Film at thirteen and a half seconds shows the left atrium densely opacified and the left ventricle faintly opacified, with a sharp line of demarcation.

This appearance has been wrongly considered "characteristic" of mitral stenosis.

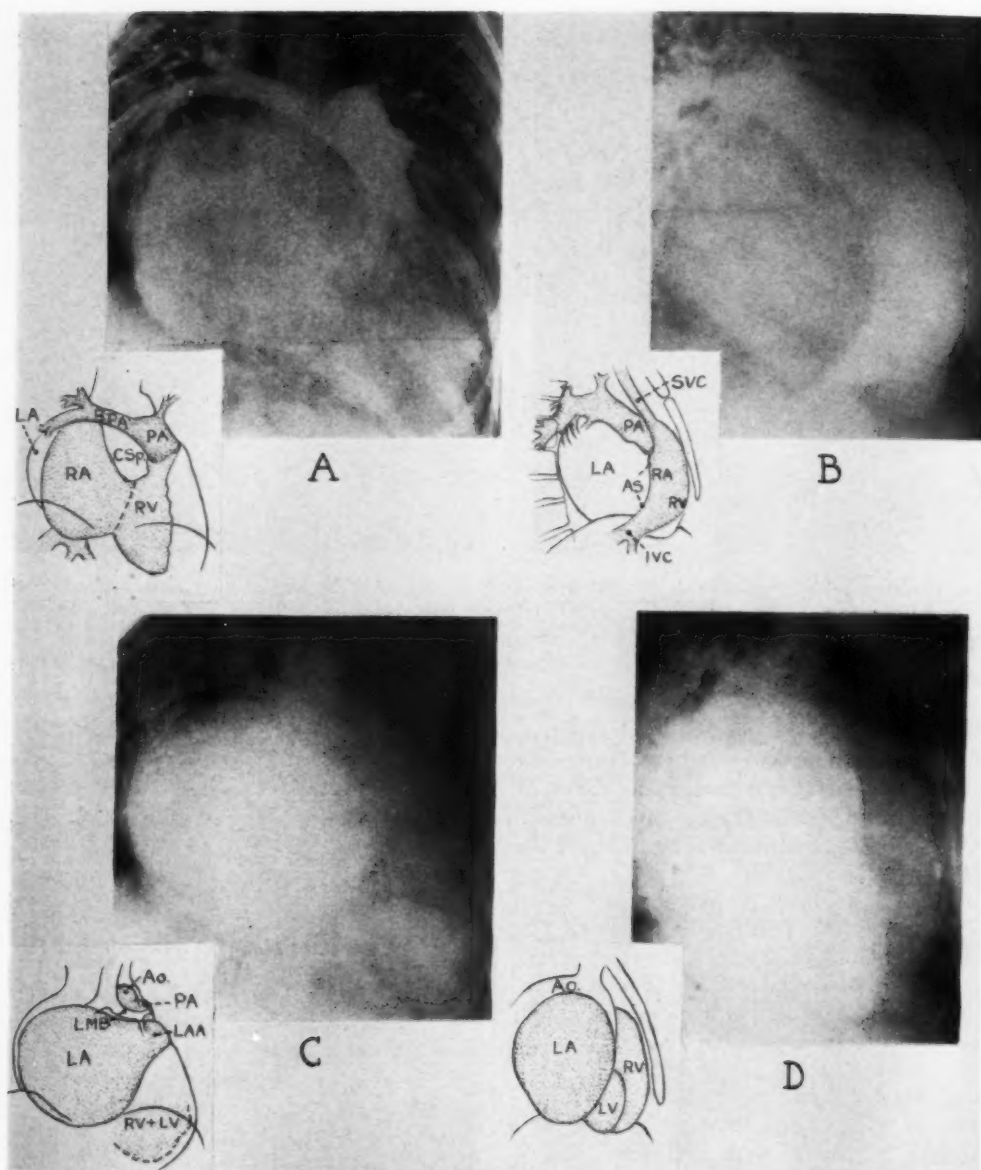


Fig. 5. A and B at three seconds; C and D at ten seconds.

"Pure" mitral insufficiency at surgery. The angiographic diagnosis was mitral stenosis, based on the small size and faint filling of the left ventricle (D). The enormous left atrium, densely opacified (C), is elevating the left main bronchus and the right pulmonary artery (A), and producing marked anterior bowing of the atrial septum (B). The ventricular opacification in C is a composite density of both ventricles. Note the moderate displacement of the right chambers and enclosed clear space (C Sp) to the left (A).

chambers were studied. No correlation with the presence of stenosis or insufficiency was found, and there was no relation between the degree of stenosis as seen at

operation and the prolongation of the circulation times. The slow circulation times, however, tended to occur in patients with marked cardiac enlargement.

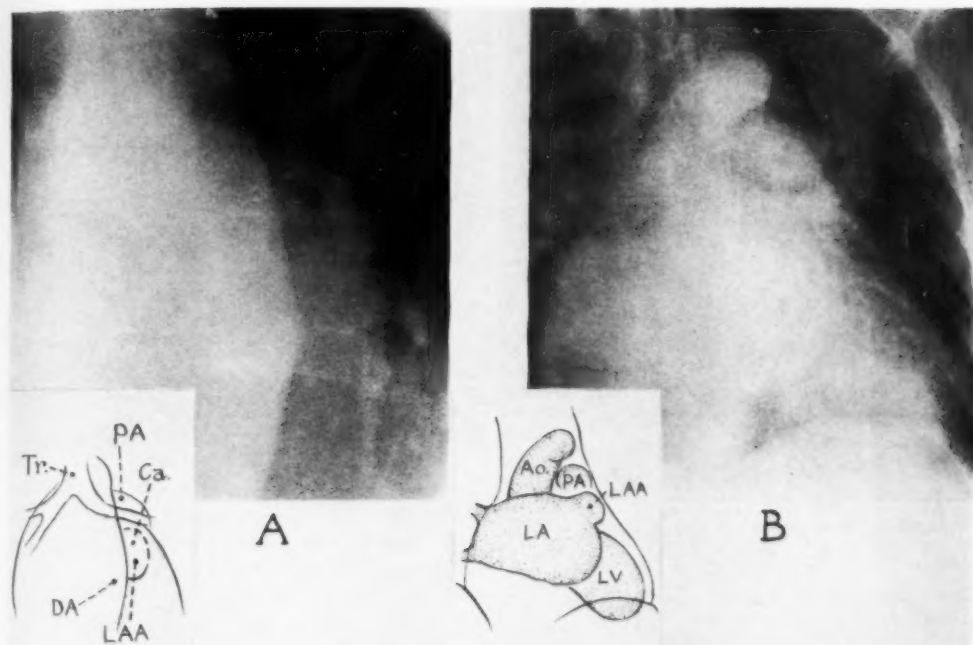


Fig. 6. Thrombus in the left auricular appendage and mitral stenosis found at surgery.

- A. Plain film. A rim of calcium in the wall of the appendage is visible.
 B. Angiocardiogram at twenty-five seconds. The thrombus is not visualized, in spite of the dense opacification of the left atrium.

Attempts to measure the thickness of the left ventricular wall for the demonstration of hypertrophy were not rewarding. Measurements made on various films of the same patient in ventricular systole were quite variable, but when made in diastole, they were fairly constant. In 22 cases, measurements could not be made because the opacification of the left ventricle was too faint. In 8 cases, the left ventricular wall in diastole was 7 to 9 mm. thick. In all 8 cases predominant stenosis was found at surgery. These measurements were considerably less than those in postmortem material, because the dying human heart stops beating in systole (5). In 2 patients the ventricular walls exceeded 10 mm.: 1 proved to have stenosis at surgery and 1 regurgitation.

It was found that auricular fibrillation could be consistently diagnosed on the angiogram by the complete uniformity of the size and shape of the atria in serial films. Even on the basis of single

films, there appeared to be a fairly constant relation between the size of the two atria and the presence or absence of fibrillation. Thus, of 18 patients with auricular fibrillation, 17 had moderate to marked enlargement of both atria and in only 1 was the enlargement minimal. All patients with very large atria had auricular fibrillation.

There were 6 patients in whom the left atrium was of enormous size. Two of these were found at surgery to have insufficiency (Fig. 5), and 4 stenosis. The presence of a "giant" left atrium was therefore not characteristic of either lesion. In the process of enlargement of the left atrium, all three of its dimensions were involved; but even with extreme enlargement, it did not usually become completely spherical. No relation between left atrial pressures measured at surgery and left atrial size was found. In 4 cases surgery revealed a thrombus in the left auricular appendage; this was suspected preoper-

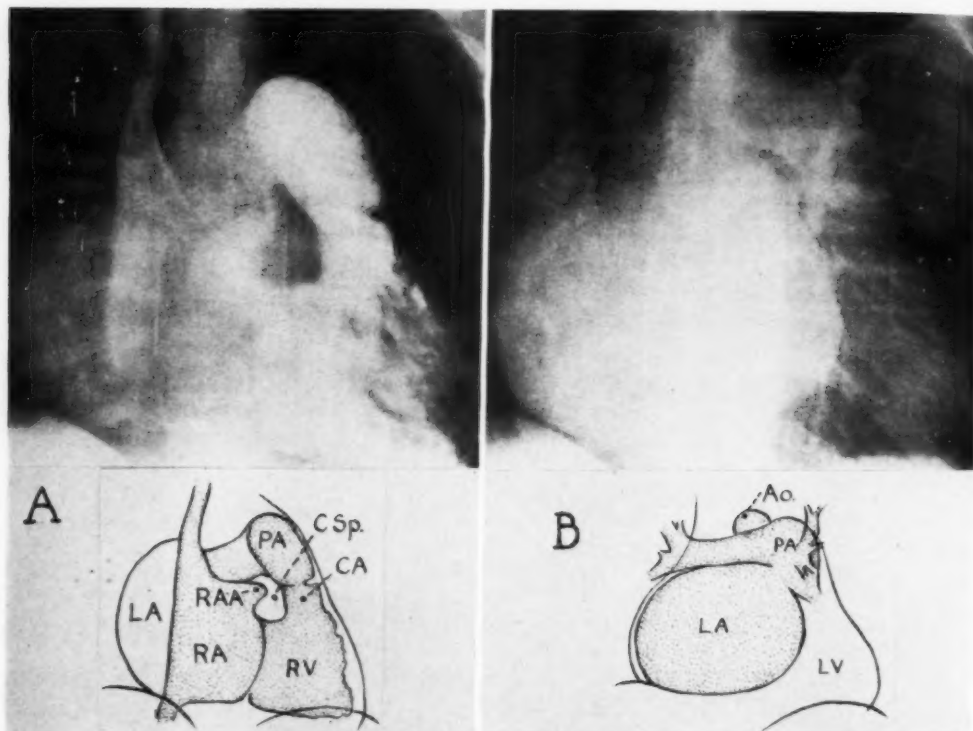


Fig. 7. Mitral stenosis at surgery.

A. One second after injection. There is definite counterclockwise rotation of the heart, with displacement of the right chambers and enclosed clear space (C Sp) to the left (A). The conus arteriosus (CA) of the right ventricle forms a part of the left heart border.

B. Nine and a half seconds after injection. The enlarged left atrium forms the right heart border.

actively in only 1 case because the wall of the appendage was calcified (Fig. 6). None of the thrombi was visible as a filling defect in the angiocardigram. Two patients showed non-filling of the auricular appendage in spite of good opacification of the atrium. This, however, occurred in several other cases in the absence of thrombi (Fig. 1).

Our study would appear to confirm the work of Grant (5), who found little significant counterclockwise rotation of the heart in various types of cardiac disease postmortem. His study raised considerable doubt as to the reliability of assessing cardiac rotation by "unipolar" electrocardiography. Angiocardigraphy is probably the most accurate means of assessing rotation of the heart during life. In 30 of the cases of this series, no signifi-

cant rotation was observed. In the remaining 2 cases (Figs. 5 and 7), the rotation would appear to be secondary to extreme left atrial enlargement. The right heart border in the frontal projection was taken over completely by the left atrium; the U-shaped central clear space between the right atrium and pulmonary artery was displaced to the left. The conus arteriosus of the right ventricle and anterior interventricular septum approached the left heart border.

In addition to engorgement of the venae cavae, dilatation and marked retrograde filling of the azygos vein were usually seen in the early angiocardigraphic films. In 2 cases, marked retrograde opacification of the coronary sinus occurred (Fig. 1), an unusual finding in normal angiocardigrams.

In only 1 case was angiocardiology done both before and after surgery. As in the cases of Actis-Dato *et al.*, the right chambers and left atrium appeared smaller, the left ventricle larger, and the opacification times shorter following commissurotomy.

CONCLUSIONS

Angiocardiology as performed with present technics was not a reliable procedure for distinguishing between mitral stenosis and insufficiency in 32 cases proved by surgery. The diagnostic accuracy was poorer than that of conventional clinical methods. Both "false positive" and "false negative" diagnoses of mitral stenosis were made. In this, as in other unselected series, cases with stenosis predominated. The problem of selecting the small minority of cases with predominant insufficiency has not been solved by angiocardiology.

No difference in the "opacification pattern" of the left atrium and ventricle was observed in stenosis and insufficiency which could not be explained on the basis of chamber size and cardiac phase. The prolonged opacification of the left atrium seen in mitral disease is due to its large size and the generalized slowing of the circulation. In the absence of shunts, the output (volume per unit time) in all chambers of the heart remains equal; there is no specific "hold-up" of the contrast medium in the left atrium by a stenotic mitral valve.

Angiocardiology is of value in demonstrating the size and position of the cardiac chambers, but this can usually be assessed by ordinary roentgenographic means. Left ventricular enlargement was

demonstrated in only 2 out of 5 cases of proved "pure" mitral insufficiency.

It may be possible in the future to visualize the mitral valve orifice by selective angiocardiology performed through a direct left atrial puncture.

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SUMARIO

La Angiocardigrafía en el Diagnóstico Preoperatorio de la Estenosis y la Insuficiencia Mitrals

Los AA. ejecutaron la angiocardigrafía en 50 casos de cardiopatía mitral reumática, 32 de los cuales fueron comprobados quirúrgicamente. En este último

grupo es que se basa este trabajo. La angiocardigrafía no resultó ser un procedimiento fehaciente para diferenciar entre la estenosis mitral y la insuficiencia

mitral, poseyendo menos exactitud diagnóstica que los métodos clínicos aceptados generalmente.

Se hicieron diagnósticos tanto seudopositivos como seudonegativos de estenosis mitral. En esta serie, así como en otras sin selección, predominaron los casos de estenosis. El problema de seleccionar la pequeña minoría de casos en que predomina la insuficiencia no ha sido resuelto por la angiocardiografía.

No se observó en la estenosis y la insuficiencia diferencia alguna en el "patrón de opacificación" que no pudiera explicarse a base del tamaño de la cavidad y de la fase cardíaca. La opacidad prolongada de la aurícula izquierda observada en la afec-

ción mitral se debe al gran tamaño de aquélla y al retardo generalizado de la circulación. A falta de desviaciones, la producción (volumen por unidad de tiempo) permanece igual en todas las cavidades del corazón; no hay "paro" específico del medio de contraste en la aurícula izquierda por una válvula mitral estrechada.

La angiocardiografía es de valor para revelar el tamaño y la posición de las cavidades cardíacas, pero esto puede determinarse por lo general con los medios radiográficos ordinarios. No se descubrió hipertrofia del ventrículo izquierdo más que en 2 de 5 casos de insuficiencia mitral "pura" comprobada.



Dextroposition of the Descending Thoracic Aorta

GORDON L. SNIDER, M.D., HYMAN L. GILDENHORN, M.D., and LAURENCE H. RUBENSTEIN, M.D., F.A.C.S.

THE LAST TWO decades have seen a steady fall in the morbidity and mortality of thoracic surgical procedures. As a result, where other diagnostic procedures have failed, it has become accepted practice to perform exploratory

additional cases. The importance of pre-operative diagnosis and the paucity of references in the literature to a buckled descending thoracic aorta presenting as a mass in the right hemithorax have prompted the reporting of these 3 cases.

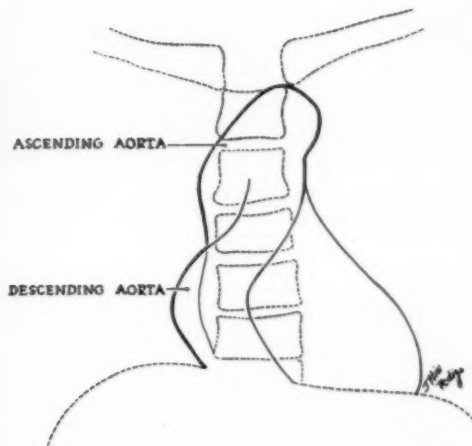
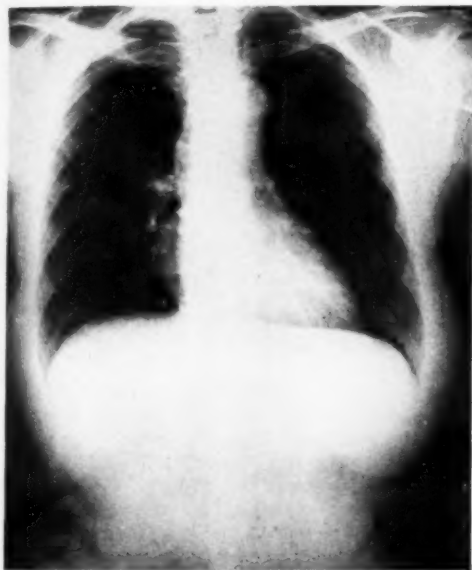


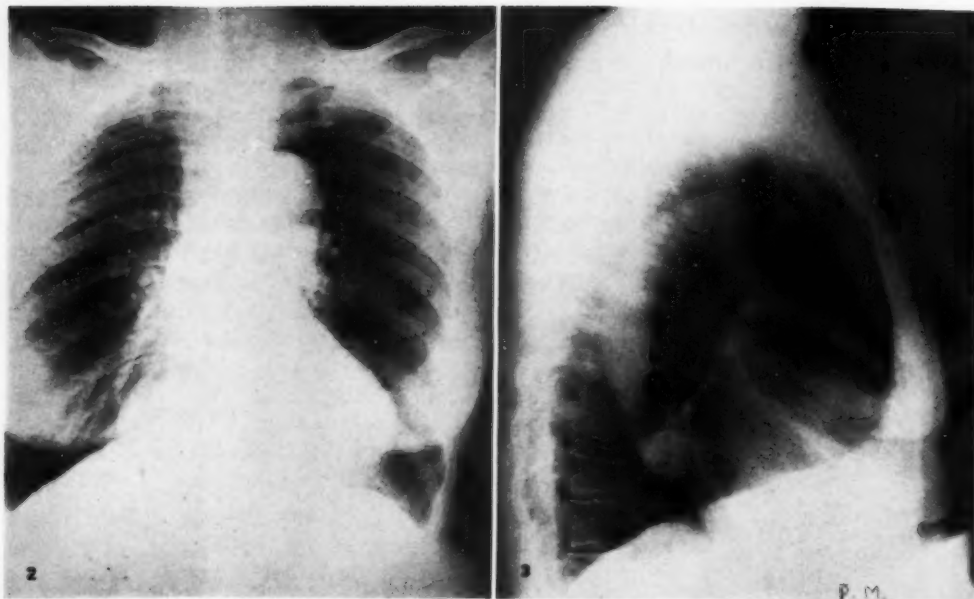
Fig. 1. Case I: Postero-anterior roentgenogram. The sweep of the descending thoracic aorta beyond the right heart border simulates a mass projecting from the mediastinum into the right lower lung field. This finding was confirmed at thoracotomy.

thoracotomy for accurate diagnosis of mediastinal masses. In April 1953, one of us (L. H. R.) performed an exploratory thoracotomy on a patient with a rounded mass in the right cardiophrenic angle. The mass was found to be a greatly elongated descending thoracic aorta which had crossed in front of the spine into the right hemithorax, turned sharply on itself, and re-entered the left hemithorax. This case alerted us to the possibility of this condition and resulted in the collection of 2

CASE I: A 51-year-old white female, a patient in the Manteno State Hospital, was found, on a chest survey, to have a mass in the right cardiophrenic angle. Subsequent fluoroscopy and roentgen examination confirmed the presence of this mass (Fig. 1). Physical examination of the heart and lungs was essentially negative. The blood pressure was within normal limits. The Kahn test was negative.

An exploratory thoracotomy, performed in April 1953, showed the mass to be an elongated tortuous descending thoracic aorta which had made a sharp bend on itself, with the apex of the loop projecting into the right hemithorax. The patient made an uneventful recovery.

¹ From the Chest and Diagnostic Roentgenology Departments of Michael Reese Hospital and the Chest Surgical Service, Department of Welfare, State of Illinois, Dr. Ernest Teller, Tuberculosis Control Director. Accepted for publication in October 1955.



Figs. 2 and 3. Case II: The postero-anterior view (Fig. 2) shows an abnormal density in the right cardiophrenic angle, the nature of which is not readily apparent. The right lateral roentgenogram (Fig. 3) shows an ovoid density projected on the shadow of the lower thoracic aorta.

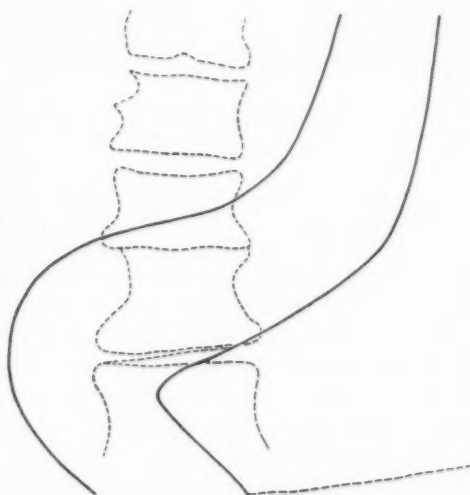


Fig. 4. Case II: Spot roentgenogram in right posterior oblique projection. The density seen in Figs. 2 and 3 is actually the sharply buckled descending thoracic aorta which crosses into the right hemithorax and then turns sharply on itself to exit from the thorax.

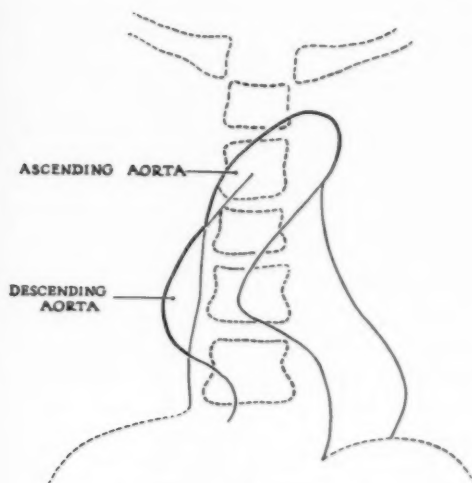
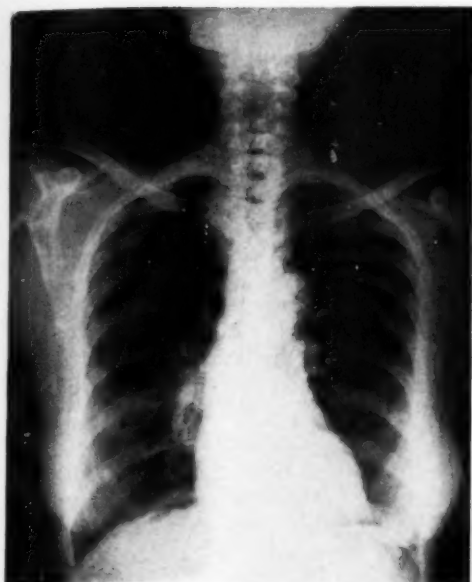


Fig. 5. Case III: Postero-anterior roentgenogram showing a rounded density projecting beyond the right heart border, obscuring the right hilus. Contiguity with the descending thoracic aorta both above and below can be faintly distinguished. The greater density of the aorta makes this case less of a diagnostic problem than Cases I and II.

CASE II: A right cardiophrenic angle mass was discovered in an 80-year-old colored female on a routine x-ray survey in March 1950, shortly after her admission to the Mandel Clinic of Michael Reese Hospital. The patient had mild exertional dyspnea and occasional mild non-productive cough at night. There were no other symptoms referable to the cardiorespiratory system. Physical examination of the heart and lungs was within normal limits. The blood pressure was 150 mm. Hg systolic and 90 mm. Hg diastolic.

Roentgen examination of the chest in the frontal projection (Fig. 2) revealed a prominent calcified aortic knob and a dense mass in the right cardiophrenic angle. Fluoroscopic examination and oblique films showed the descending thoracic aorta to be buckled sharply to the right, just above the diaphragm. It was this knuckle of aorta that produced the shadow in the right cardiophrenic angle (Figs. 3 and 4). There was enlargement of the outflow tract of the left ventricle. Follow-up over a three-year period showed no change in the patient's clinical status or in the appearance of the aorta.

CASE III: A 73-year-old Negro female had a mass in the right mediastinum, discovered on a chest survey roentgenogram taken on admission to the Mandel Clinic of Michael Reese Hospital, in October 1953. She gave a one-year history of mild dyspnea and chronic cough productive of scanty mucoid sputum. There were no other respiratory symp-

toms, nor was there any history of chest pain, orthopnea, or ankle edema. Palpitations occurred occasionally.

The patient was mildly obese and in no distress. The lungs were hyperresonant, with decreased breath sounds throughout; there were no adventitious sounds. The heart sounds were distant; the aortic second sound was louder than the pulmonary second sound. No cardiac murmurs were heard. The blood pressure was 180 mm. Hg systolic and 90 mm. Hg diastolic. The Kahn test was negative.

Frontal chest roentgenograms (Fig. 5) disclosed a rounded density projecting to the right of the right heart border, approximately 4 cm. above the right leaf of the diaphragm. Fluoroscopic examination and roentgenograms in multiple projections showed the aorta to be markedly elongated and tortuous. The descending thoracic aorta was shown to swing across the mid-line into the right hemithorax. It then turned sharply on itself back toward the mid-line, producing a knuckle at about the level of the 8th thoracic vertebra, which was seen beyond the right heart border in the frontal projection. Follow-up over a period of eighteen months showed no significant change in the patient's clinical status or in the roentgenographic appearance.

DISCUSSION

Lesions of the aorta are of great importance in the preoperative differential

diagnosis of abnormal mediastinal shadows. Blades (1) reported a series of 114 suspected mediastinal tumors which were explored surgically. Aortic aneurysms proved to be the cause of the abnormal roentgenologic shadow in 5 cases. Corcoran and Coleman (2) described a case in which a tortuous aorta projecting into the left hemithorax came to surgery as a possible mediastinal tumor. Santy *et al.* (3) found an aneurysm of the descending thoracic aorta at thoracotomy performed with the preoperative diagnosis of neurofibroma.

Instances of congenital right-sided descending aorta are numerous (4, 5), and syphilitic aneurysms of the descending thoracic aorta have also been reported as appearing in the right lung field (6, 7). On the other hand, projection of a tortuous arteriosclerotic descending aorta into the right lung field has rarely been recorded.

An arteriosclerotic aorta with an aneurysm of the descending limb encroaching on the right lung hilus is reported by Epstein and Friedman (8), and Zdansky (10) cites a single case reported by Pape (11) in this category. Breda and Costa (12) also present a case of dextroposition of an elongated aorta due to its descending limb turning to the right. In this instance the tortuous aorta extended to the right of the spine but was entirely obscured by the heart shadow. Dotter and Steinberg (14), in discussing tortuosity of the arteriosclerotic descending aorta, remark that it may project toward the right heart border. Their angiocardio-grams show a case similar to that of Segers and Brombart (13), with the aorta hidden behind the right heart shadow.

Roesler (15), in his textbook, makes the following comment: "The descending aorta (in cases of elongation and widening seen in the aged and in hypertensive cardiovascular disease) may make an abnormal prominence into the left, or very rarely, into the right lung field."

In Case 4 of Levene *et al.* (19) there was an elongated aorta in which the descend-

ing portion formed as "S" curve. The bowing of the lower descending portion was responsible for prominence of the right cardiac border. These writers point out that the buckling which results from the marked elongation of the arteriosclerotic thoracic aorta produces the greatest changes in the descending portion, which may project markedly to the right or left of the spine.

Mucklow and Smith (20) report a case in a sixty-six-year-old woman with a history of pain behind the lower sternum, a sensation of food sticking, and vomiting after meals, since the age of twenty. A diagnosis of neurofibroma was entertained after roentgen demonstration of a mass presenting in the right cardiophrenic angle, which lay behind the esophagus and displaced it forward. More careful evaluation showed the mass to be the descending thoracic aorta, which followed a tortuous course, passing almost horizontally from left to right at the level of the 10th thoracic vertebra. Keates and Magidson (21) report 7 cases of dysphagia due to external compression of the esophagus by a sclerotic aorta. In 2 of their cases the descending aorta crossed to the right of the mid-line.

Since the aorta is relatively fixed at its point of origin from the heart and at its point of exit through the diaphragm, and is relatively mobile between these two points, elongation due to arteriosclerosis results in tortuosity and buckling.

Aortic dilatation occurs with arteriosclerosis but is rarely marked unless there is complicating hypertension or syphilis. The cases presented here displayed little increase in caliber of the aorta. The blood pressure in Case I was within the normal range. The systolic pressure was at the upper limit of normal in Case II and moderately elevated in Case III. The diastolic pressures were normal. It seems more likely that the elevation of systolic pressure was a result of sclerosis of the aorta rather than its cause. Serological tests for syphilis were negative in all 3 cases. Thus, arteriosclerosis seems re-

sponsible for the aortic elongation in all of these patients. The ages of the second and third patients, eighty and seventy-three years respectively, are compatible with this etiology, but the age of the first patient, fifty-one years, is somewhat unusual for so marked a degree of arteriosclerosis, although there are reports of similar cases (22). A careful search of the literature failed to disclose the occurrence of buckling of the descending thoracic aorta on a congenital basis, although such a possibility cannot be excluded in this instance. While the condition is one to be thought of primarily in patients who are over sixty years, it apparently may occasionally be met with in younger persons.

In Cases I and II, buckling of the descending thoracic aorta formed a loop which projected beyond the lowermost part of the right heart border in the frontal projection and thus simulated a mass in the right cardiophrenic angle. In Case III the knuckle of descending aorta protruded beyond the right heart border at a higher level. This presented less of a diagnostic problem, since the most distal portion of the thoracic aorta could be faintly distinguished through the heart as it recurved to the left to exit from the thorax.

Providing the condition is suspected, careful roentgenoscopy and roentgenograms made in the left anterior oblique or right posterior oblique projections, with barium in the esophagus, will usually lead to the diagnosis of buckling of the descending thoracic aorta to the right. In difficult cases, venous angiocardigraphy or retrograde aortography will probably establish or exclude the diagnosis.

SUMMARY

1. Three cases of buckling of the descending thoracic aorta are presented, in which the vascular shadow masqueraded as a mediastinal mass projecting beyond the right heart border. The evidence favors arteriosclerosis as the cause of the tortuosity of the aorta in all of these cases.

2. One case was subjected to exploratory thoracotomy to exclude the possibility of mediastinal tumor.

3. The literature on dextroposition of the aorta has been reviewed. There is a paucity of reports of sclerosis of the aorta as an etiologic factor in this condition, although syphilis and congenital right-sided descending thoracic aorta are frequently noted.

4. If there is a high index of suspicion, the condition may be diagnosed by fluoroscopy and appropriate roentgenograms. Angiocardiography may be helpful in difficult cases.

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SUMARIO

Dextroposición de la Aorta Torácica Descendente

Preséntanse 3 casos de torcimiento de la porción ascendente de la aorta torácica, en los que la sombra vascular parecía una tumefacción mediastínica que proyectaba más allá del borde derecho del corazón. Los datos disponibles apoyan la arteriosclerosis como causa de la tortuosidad de la aorta en los 3 casos. Un enfermo fué sometido a una toracotomía exploradora para excluir la posibilidad de tumor del mediastino, observándose que la alargada y tortuosa aorta descendente se había doblado agudamente sobre sí misma, proyec-

tando el vértice de la curva al hemitórax derecho.

Repasada la literatura relativa a la dextroposición aórtica, encontráronse pocas referencias a la esclerosis como factor etiológico, aunque eran numerosos los casos de aorta descendente dextrolateral congénita y los vinculados con sífilis.

Si hay vivas sospechas, puede diagnosticarse la situación roentgenoscópicamente y con radiografías apropiadas. La angiocardiografía puede resultar útil en los casos difíciles.



Anomalous Course of Left Pulmonary Artery with Respiratory Obstruction¹

MARTIN H. WITTENBORG, M.D., THAVI TANTIWONGSE, M.D., and BARBARA F. ROSENBERG, M.D.

ANATOMIC variations of intrathoracic vessels, particularly of the aortic arch, are now well recognized as a cause of respiratory obstruction in infants and children. Although the variety is almost infinite, these anomalies may be classified into a few broad groups, depending on their anatomic course and the func-

or a straight ante-tracheal course. The group consists of aberrant subclavian vessels, the aberrant innominate artery, and rarely an aberrant common carotid. These cases, although they are much more common than those of the first group, have a far lower incidence of symptoms, probably less than 3 per cent. The surgical

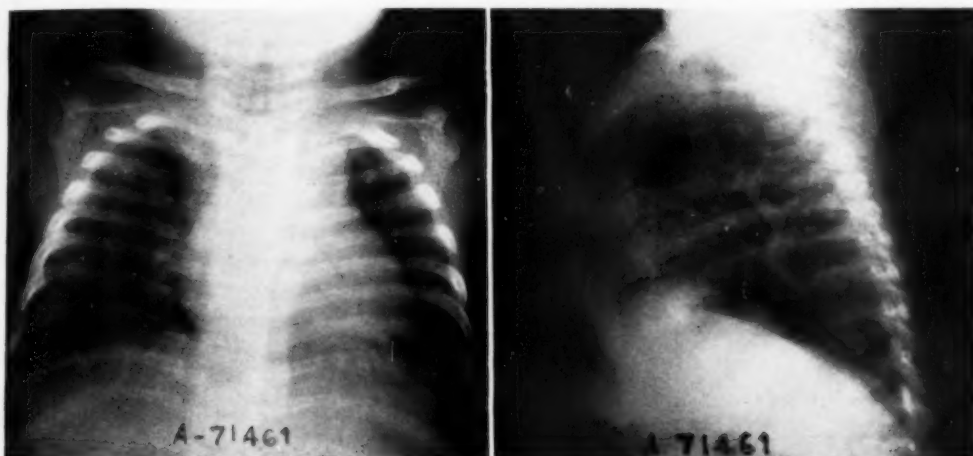


Fig. 1. Case I: Chest roentgenograms at eleven weeks of age, showing slight irregularity of aeration of the lungs, mild generalized emphysema with increased anteroposterior diameter of the chest, and narrowing of the tracheal lumen (seen on the lateral film) in the upper intrathoracic region.

tional or physiologic disturbance which they produce. The true vascular rings, including the double aortic arch and the right aortic arch with a ligamentum arteriosum, encircle both the trachea and esophagus, giving rise to respiratory symptoms in at least 85 per cent of afflicted patients. A second group is made up of individual vessels of the aortic arch having an anomalous origin and course, arising contralaterally to their destined blood distribution and compressing either the trachea or esophagus in crossing the mid-line. The compression defect and symptoms depend on whether the vessel pursues a retro-esophageal, an ante-esophageal, a retro-tracheal,

treatment has been well defined (1). Belonging in the second group, but not emphasized in clinical papers on aortic-arch anomalies and mediastinal vascular malformations, is an anomalous course of the pulmonary artery producing respiratory symptoms.

The following report of 2 cases in which the left pulmonary artery followed an anomalous course, producing definite respiratory obstruction, gains significance in light of 3 other cases recently published. These patients present a similar clinical picture, not unlike that of the double aortic arch, and the defects are also amenable to diagnosis and surgical correction.

¹ From the Departments of Radiology and Pathology, The Children's Hospital and Harvard Medical School, Boston, Mass. Accepted for publication in October 1955.

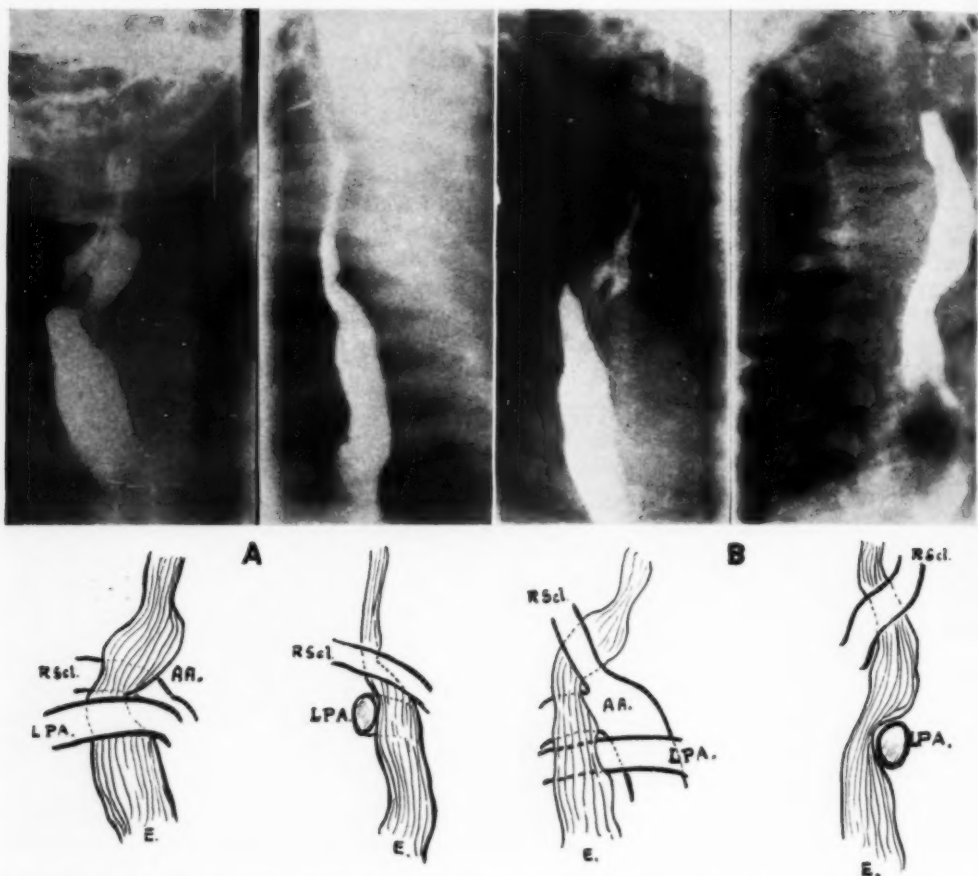


Fig. 2. Case I: A. Spot films during fluoroscopy show the constant indentations in the esophagus (E). A posterior indentation, running obliquely cephalad from left to right at the level of the aortic arch (AA), presents the characteristic appearance of an aberrant right subclavian artery (RScl) arising to the left of the mid-line and running behind the esophagus. In addition, an indentation is evident in the anterior and left lateral aspect of the esophagus at a slightly lower level, caused by the anomalous position of the left main pulmonary artery (LPA), as indicated in the line drawing.

B. Left anterior oblique and right anterior oblique views of the barium-filled esophagus (E) show the indentation in the anterior and left lateral aspect of the barium-filled esophagus produced by the left pulmonary artery (LPA) to somewhat better advantage than the straight anteroposterior and lateral projections. The esophageal indentations of the aortic arch (AA) and right subclavian artery (RScl) can also be visualized. Apparently, no obstruction to the flow of barium through the esophagus was produced by either of these anomalous vessels.

CASE REPORTS

CASE I: An 11-week-old white male infant was admitted to The Children's Medical Center of Boston with a history of poor weight gain and noisy respirations. He had failed to respond to general and supportive therapy elsewhere. Birth weight was 6 pounds, 2 ounces. At four days of age, intermittent wheezing and respiratory difficulties, with exacerbation during feeding, and a profuse nasal discharge were observed. At seven weeks, the child was admitted to another hospital with these symptoms plus failure to gain weight.

On admission to The Children's Medical Center,

the weight was 7 pounds, 4 ounces, the temperature 100° F., pulse 144, and respirations 32. The neck was dorsiflexed, there was flaring of the alae nasi, and the upper chest and suprasternal notch retracted with each respiration. No cyanosis or cough was noted, but the cry was feeble. The anteroposterior diameter of the chest was increased, there was hyperresonance to percussion, and loud inspiratory and expiratory coarse râles were heard throughout both lung fields. The concentration of hemoglobin was 10 gm. per 100 c.c. of blood. *Streptococcus pyogenes* and a few yeasts were present in the nose and throat. The test for trypsin in the

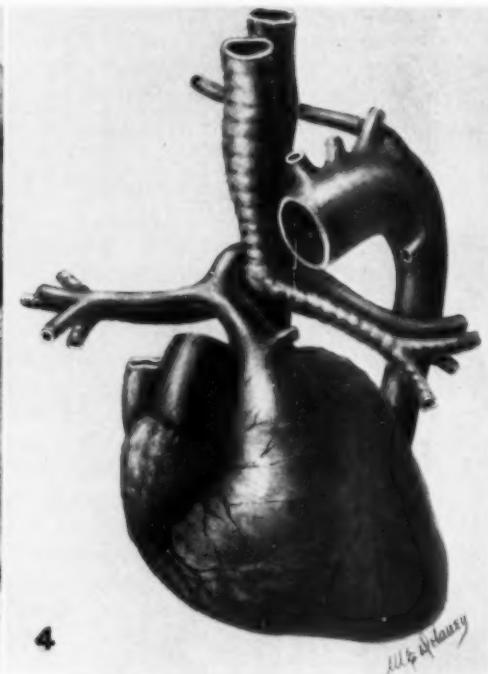


Fig. 3. Case I: Anterior view of the thoracic organs with aortic arch reflected inferiorly to expose the course of the aberrant left pulmonary artery as it runs behind the trachea. The anatomic relations are reconstructed in Figure 4.

Fig. 4. Semidiagrammatic representation of Figure 3. The heart is rotated slightly, the aortic arch is displaced superiorly, and a segment has been removed to show the course of the left pulmonary artery between the trachea and esophagus and the intrinsic narrowing of the lower portion of the trachea. The positions of the ligamentum arteriosum (which has been divided) and the aberrant right subclavian artery are also illustrated.

stool was positive, and values for sweat electrolytes were in the low normal range.

Chest roentgenograms revealed a diffuse non-specific prominence of the bronchovascular markings with marginal loss of definition, suggesting a mild inflammatory congestion, peribronchial in distribution (Fig. 1). There was mild diffuse emphysema of the lungs. The trachea was narrowed in its intrathoracic portion but was not displaced. Barium studies (Fig. 2) revealed a posterior indentation in the esophagus at the level of the aortic arch, running obliquely cephalad from left to right, characteristic of an aberrant right subclavian artery with a retroesophageal course. The esophageal deformity, however, was greater than that usually seen with an uncomplicated aberrant subclavian artery, and there appeared to be a slight anterior indentation in the esophagus just below the level of the aortic arch.

The bronchoscopist described a definite narrowing of the tracheal lumen just superior to the bifurcation. The bronchoscope could not be passed beyond this point. A tracheogram was scheduled but could not be obtained because of the child's poor condition. Throughout the hospital stay, antibiotic therapy was administered. Excessive pharyngeal

and tracheal secretions proved to be the most pressing therapeutic problem. Toward the end of life, cyanotic episodes were frequent. During one of these the child died.

Postmortem examination revealed malnourishment and poor development. Both lungs were emphysematous. There was no displacement of the heart or mediastinum, and the pulmonary artery and aorta had a normal relationship at their origins. The ductus arteriosus was in its usual position and was not patent. The first portion of the main pulmonary artery was a somewhat bulbous structure, measuring 15 mm. in its greatest diameter. At about 10 mm. from the valve ring the diameter narrowed to 8 mm. Here the vessel swung to the right to a point over the right main bronchus where, 14 mm. from the valve ring, it divided, forming the right and left pulmonary arteries. The right branch followed a normal course to the lung. The left branch passed over the right main bronchus, behind the trachea, and in front of the esophagus, to enter the hilus of the left lung behind both the pulmonary veins and the bronchi (Figs. 3 and 4). The trachea presented a gradual narrowing in its distal portion, decreasing in external diameter from

TABLE I: SUMMARY OF FINDINGS ON PATIENTS WITH ANOMALOUS COURSE OF LEFT PULMONARY ARTERY INCLUDING PREVIOUS CASE REPORTS

Case	Age at Onset of Symptoms	Clinical Symptoms and Signs	Physical Findings	Diagnostic Findings	Course and Treatment	Associated Congenital Anomalies Present
I	4 days	Intermittent wheezing and retraction.	Bilateral hyperresonance and coarse rales.	<i>Roentgenogram:</i> Moderately enlarged heart, bilateral narrowing of lower trachea. <i>Barium swallow:</i> Deformity suggesting aberrant subclavian artery. <i>Bronchoscopy:</i> Marked constriction of trachea just above carina.	Repeated severe cyanotic spells in spite of supportive therapy. Death at 3 months of age.	Aberrant right subclavian artery. Persistent left superior vena cava. Hydropneumothorax of left kidney. Hemivertebrae. Incomplete rotation of intestine.
II	2 weeks	Cyanotic spells, convulsions.	Enlarged heart with systolic murmur.	<i>Roentgenogram:</i> Normal.	Death at 3 weeks of age during cyanotic attack, having aspirated.	Dextroposition of aorta, interventricular septal defect, coarctation of aorta, possible mongolism.
III Welsh and Munro (2)	2 weeks	Expiratory wheezing, no relation to feeding. Repeated respiratory infections, stridor, and retraction.	Coarse crepitation, both lung fields.	<i>Roentgenogram:</i> Normal. <i>Laryngoscopy:</i> Normal.	Left thoracotomy at 6 months. Death in cardiac arrest.	None mentioned.
IV Potts et al. (3)	At birth	Dyspnea, cyanosis, expiratory wheezing, and retraction.	Decreased breath sounds on right. Shift of heart to left.	<i>Roentgenogram:</i> Emphysema of right lung; displacement of heart and mediastinum to left. <i>Bronchoscopy:</i> Deviation of trachea to left; compression of right bronchus, probably extrinsic.	Surgical section and anterior anastomosis of pulmonary artery through right thoracotomy at 5 months. No symptoms except occasional stridor.	None mentioned. Patient still living at time of publication.
V Morse and Gladding (4)	At birth	Wheezing, dyspnea, and cyanosis.	Absence of breath sounds on right, changing to hyperresonance. Retraction. At 10 days mediastinum shifted to left.	<i>Bronchoscopy:</i> Same. <i>Roentgenogram:</i> At 4 days, atelectasis; right lower and left upper lobes; at 10 days, obstructive emphysema, right lung; marked herniation of mediastinum to left.	Pulmonary artery freed and reattached through right thoracotomy. Patient did well at first; died 11 days postoperatively.	None mentioned.

8 mm. over a distance of 3 cm. to 4 mm. at the carina. No abrupt narrowing or softening of the cartilaginous rings was present at the point of partial encirclement by the left pulmonary artery. The right main stem bronchus was of normal caliber and thickness.

There were several associated vascular anomalies. An aberrant right subclavian artery arose directly from the aortic arch, just beyond the left subclavian and before the ductus arteriosus, passing diagonally upward and to the right, behind both the trachea and esophagus. A persistent left superior vena cava was present, which entered the coronary sinus. When the heart was opened, the foramen ovale was found to be patent, measuring 4 by 6 mm. Additional anomalies included absence of the left kidney and ureter, partial malrotation of the intestines, and fusion of the third and fourth lumbar vertebrae.

CASE II: Search of our hospital records revealed an identical deformity of the left pulmonary artery discovered at autopsy in a male infant (Table I and Fig. 5). Unfortunately, detailed clinical notes were not available in this case, but the history was one of respiratory distress, apparently since birth, associated with cyanotic episodes and convulsions. On examination, mongolism was suspected. There was some cardiac enlargement with a systolic murmur. A roentgenogram of the chest was interpreted as normal. Neither fluoroscopy nor other specialized examinations could be performed, and death occurred during a cyanotic episode at the age of three weeks. In addition to the anomalous course of the left pulmonary artery, which produced respiratory obstruction, as illustrated in Figure 5, autopsy revealed a coarctation of the aorta.

The 3 almost identical cases seen in the past two years were reported by Welsh and Munro in 1954 (2), Potts and his associates in 1954 (3), and Morse and Gladding in 1955 (4). All the patients were males. The symptoms and clinical findings, as well as those for our 2 patients, are listed in Table I.

The anatomic relations of the pulmonary artery to the right main bronchus, trachea, and esophagus have been reconstructed from the pathologic and surgical descriptions of the reported cases and are shown schematically in Figure 5. The gross similarity in these 5 cases is striking, but slight differences are evident in the manifestations of the respiratory obstruction, depending on whether the maximal deformity involved the distal portion of the trachea or the right main stem bronchus. Three of the patients had respira-

tory distress secondary to deformity of the trachea, with bilateral emphysema. In 2, the major obstruction appeared to involve the right main bronchus, with resulting obstructive emphysema of the right lung.

DISCUSSION

One can only speculate on the embryologic explanation of the anomalous course taken by the left pulmonary artery in these cases. Persistence of the primitive "pulmonary" arch is not applicable, as it would not account for the unusual position of the artery between the trachea and the esophagus. A more likely explanation appears to lie in the mechanism of anomalous vessel formation from the primitive plexus about the esophagus and tracheal bud (5). As the pulmonary arches are in the process of formation by the union of sprouts from the dorsal and ventral aorta (the latter actually representing the primitive pulmonary artery), an adventitious union with the intricate esophagotracheal plexus may occur. Eventually, a single channel remains, running between the trachea and esophagus. The same phenomenon has frequently been suggested as accounting for the rare occurrence of an aberrant right subclavian artery lying between the trachea and esophagus rather than behind the esophagus, as is usually the case. It is possible that the intrinsic narrowing of the trachea can be explained by a partial deprivation of its normal fetal blood supply in the same manner.

Clinically, these cases fall into the group characterized by infantile respiratory obstructive symptoms of stridor or wheezing, beginning at birth or shortly thereafter. They differ, however, from the extrathoracic respiratory obstructive lesions, namely, the congenital laryngeal stridors, in that the difficulty is not a true inspiratory stridor but is predominantly an expiratory wheezing; also, in the fact that the lungs may show obstructive emphysema. The symptomatology resembles that of any of the intrathoracic tracheal or major bronchial obstructive lesions

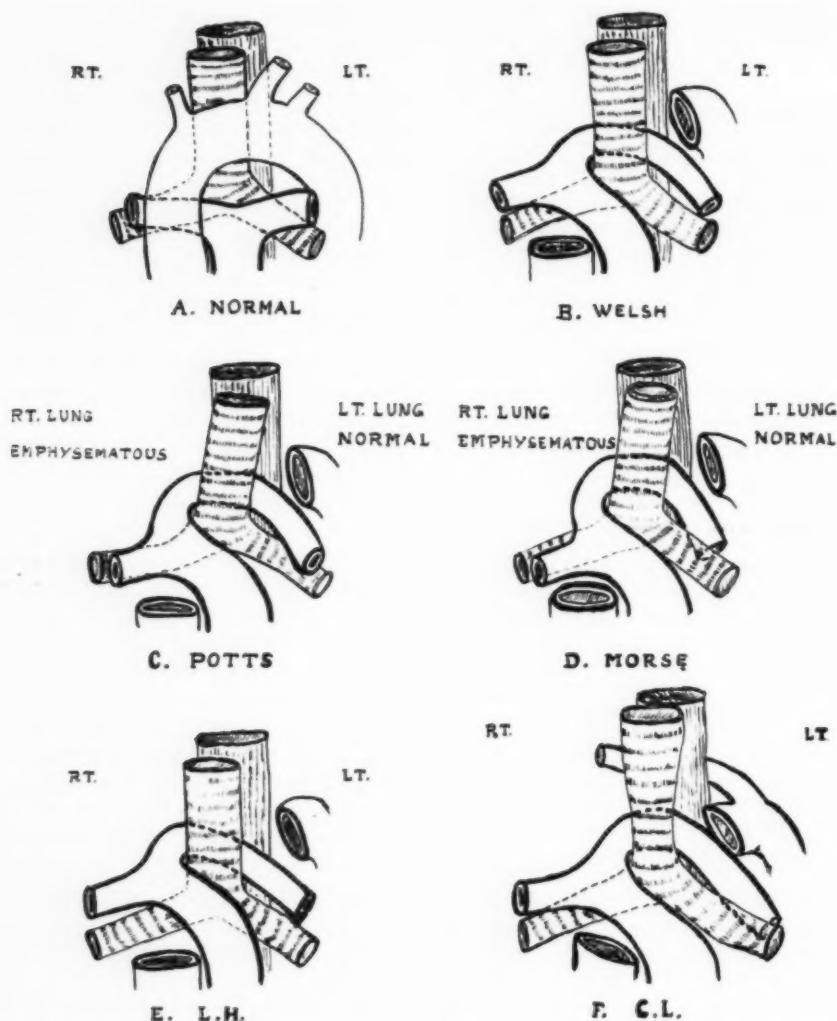


Fig. 5. Schematic anatomical reconstruction of the anomalous course of the left pulmonary artery as compared to the normal (A). Welsh's patient (B) and both of the currently reported patients, Case I (F) and Case II (E), showed no significant differential aeration of the lungs, and the major interference with the mechanics of aeration appeared to be the result of compression of the trachea. In all 3 of these patients, definite narrowing of the trachea at the site of the aberrant vessel was apparent. The narrowing in Case I (F), however, was not limited to this site, but extended well above the level that could be compressed by the vessel, and was thought to represent congenital hypoplasia. In Potts' (C) and Morse's (D) patients there was partial narrowing of the right main bronchus, with resulting obstructive emphysema on the right; in Potts' case, the right main bronchus was reported to be "paper thin at the point of pressure" (3). In Morse's case, the constriction of the right main bronchus was described as "on the superior wall" (4).

which have in common inspiratory and expiratory wheezing with pulmonary emphysema, either generalized or unilateral.

Clinically, this entity may be suspected whenever symptoms of intrathoracic respi-

atory obstruction arise at, or shortly after, birth. Roentgenograms of the chest may reveal the obstructive pulmonary emphysema, and, in addition, show a narrowing of the trachea on the lateral view, below

the level of the aortic arch. A barium swallow at fluoroscopy may definitely suggest the condition by demonstration of an anterior indentation in the esophagus at the same level. The diagnosis may be confirmed by direct bronchoscopy, a Lipiodol tracheogram, or both, if narrowing of the trachea at the carina or right main bronchus is demonstrable, particularly if it is associated with left tracheal deviation. The successful surgical correction of this deformity by Potts (3) is added incentive to pursue specific diagnosis and encourage vigorous therapy.

SUMMARY

A variation not mentioned in clinical papers on aortic arch anomalies and mediastinal vascular formations is an anomalous

course of the pulmonary artery producing respiratory symptoms. In this paper, 2 instances of the condition are presented and considered in conjunction with 3 similar cases previously published. Four of the 5 cases terminated fatally.

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SUMARIO

Trayecto Anómalo de la Arteria Pulmonar Izquierda con Oclusión Respiratoria

Una variación que no mencionan los trabajos relativos a las anomalías del cayado de la aorta y las formaciones vasculares en el mediastino es un trayecto anómalo de la arteria pulmonar produciendo síntomas en el aparato respiratorio. Presentanse aquí 2 casos de la dolencia, considerándolos junto con 3 casos semejantes publicados anteriormente. De los 5 enfermos, 3 tenían malestar respiratorio secundario a deformidad de la tráquea, con enfisema bilateral; en 2 la principal obstrucción parecía afectar el principal bronquio derecho, dando por resultado enfisema oclusivo del pulmón derecho. Cuatro de los 5 casos considerados tuvieron un desenlace letal.

Estos defectos son susceptibles de diag-

nóstico y de rectificación quirúrgica. Clínicamente, cabe sospechar la situación siempre que aparezcan en el nacimiento o poco después síntomas de oclusión respiratoria intratorácica. Las radiografías torácicas pueden revelar enfisema pulmonar oclusivo y, además, estenosis de la tráquea en la vista lateral, más abajo del nivel del cayado de la aorta. Un trago de bario puede sugerir el diagnóstico por mostrar a la misma altura una indentación anterior en el esófago. Puede confirmarse el diagnóstico con la broncoscopia directa, un traqueograma con Lipiodol o con ambos, si hay una estenosis observable de la tráquea en la quilla o el bronquio mayor derecho, en particular si va unida con desviación de la tráquea a la izquierda.

Ossification of the Pubic Bones at Birth¹

JOHN CAFFEY, M.D., and SAMUEL H. MADELL, M.D.²

THE PRIMARY ossification center for the pubic bone usually appears in the superior ramus between the fourth and sixth fetal lunar months (1, 3, 5, 10). It was detected roentgenographically in all fetuses of 340 mm. length (full term) in the series of 640 specimens reported by Francis (3). Obata (7) and Rambaud

in which two ossification centers were found in one pubic bone, early.

In a study of roentgenograms of the pelvis of 1,286 randomly selected newborn infants, we have found a variety of patterns of ossification of the pubic bone, with considerable differences in shape and size. We have arbitrarily classified

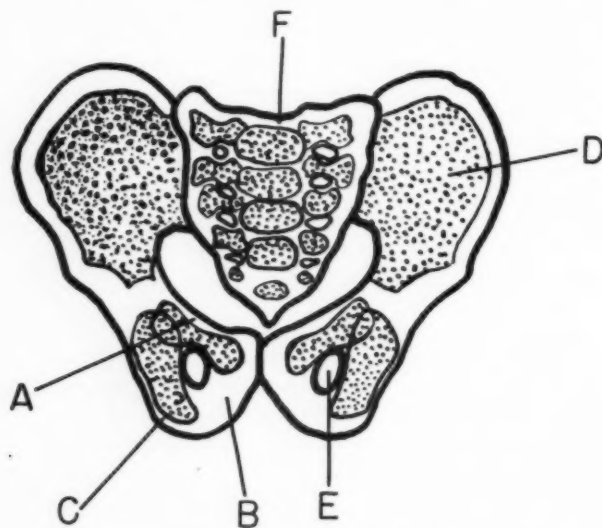


Fig. 1. Semi-schematic presentation of location of ossification centers in the pelvic cartilage at birth. Ossification centers of the different bones which are visible in roentgenograms are stippled. A. Ossified superior ramus of pubic bone. B. Non-ossified inferior ramus. C. Ilium. E. Obturator foramen. F. Sacrum.

and Renault (8) described the early center as bean-shaped and usually situated near the margin of the obturator foramen. One gains the impression from the literature that the pubic cartilage is progressively ossified evenly in a single mass (Fig. 1), until the entire pubic bone is mineralized and becomes fused with the ilium above and the ischium below. Hess (5), however, describes a single instance

the primary pubic ossification center at birth in three types according to its shape and extent (Fig. 2). In *Type A*, a single bony mass is limited to the superior ramus. Ossification does not extend as far medially as the junction of the superior and inferior rami, so that the medial end of the ossification center is not enlarged. In *Type B*, a single bony mass, shaped like a dumbbell, produces an opaque strip in the superior

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² This work was done in part while Dr. Madell was a Clinical Fellow, American Cancer Society.

TABLE I: TYPES OF OSSIFICATION CENTERS AND THEIR INCIDENCE

Type	Premature	Full-Term	All Cases	P (%)
A	12 (14.3%)	92 (7.6%)	104 (8.1%)	2.8
B	52 (61.9%)	637 (52.9%)	689 (53.6%)	11.0
C	19 (22.6%)	454 (37.7%)	473 (36.8%)	0.5
D	1 (1.2%)	19 (1.6%)	20 (1.6%)	
TOTAL	84	1202	1286	

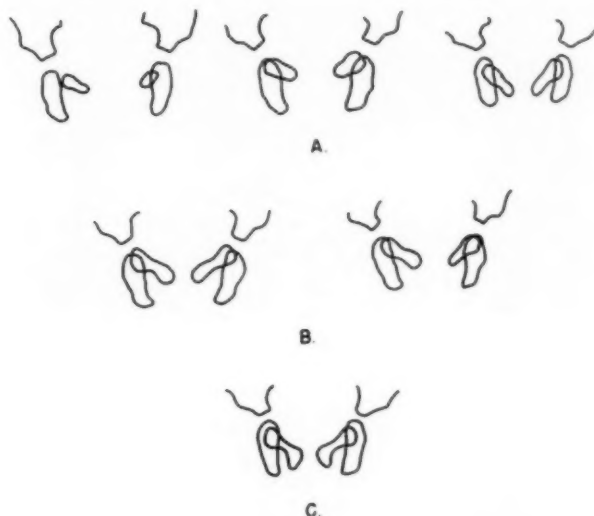


Fig. 2. Different types of ossification centers in the pubic bones. A. Three kinds of primitive centers limited to the superior ramus. B. Dumbbell-shaped ossification center with narrow middle segment and enlargements at both ends. The second figure in B shows "B" type on the right side of the pelvis and "A" type on the left side. C. Hook-shaped ossification center with extension of ossification beyond the junction of the rami into the inferior ramus.

ramus with globular expansions laterally in the body of the pubis and medially at the junction of the horizontal and descending rami. Ossification does not extend into the descending ramus. The *Type C* ossification center is shaped like a hook, owing to the extension of ossification beyond the junction of the rami into the descending ramus. A fourth type, *Type D* (Table I), includes all cases in which there are two or more ossification centers in one or both pubic bones.

The demarcation between the first three types is not absolute; one type gradually merges into the next. In one premature infant there was no mineralization of the ossification center. In some cases ossification was more advanced on one side.

The prevalence of the four types is shown in Table I. As would be expected, pubic ossification is least advanced in premature infants. This is demonstrated by the significantly larger percentage of *Type A* (14 per cent) and smaller percentage of *Type C* (23 per cent) in premature, as compared to full-term infants (8 per cent of *Type A*, 38 per cent of *Type C*) ($P=2.8$ and 0.5 respectively). Ossification is considerably more advanced in females than in males (Table II). The only significant racial difference was a higher percentage of *Type C* in white males (37 per cent) as compared to Negro males (27 per cent) ($P=1.6$).

Continuation studies, not included in this report, showed that ossification of the

TABLE II: SEX AND AGE INCIDENCE OF DIFFERENT TYPES OF OSSIFICATION CENTERS

Type	Male				Female				P (%) ^a
	White	Negro	P (%)	All Males	White	Negro	P (%)	All Females	
A	24 (6.3%)	20 (8.7%)	27.1	44 (7.4%)	25 (7.2%)	23 (9.4%)	31.7	48 (8.1%)	...
B	211 (55.5%)	140 (60.6%)	23.0	351 (57.4%)	175 (50.4%)	111 (45.5%)	23.0	286 (48.4%)	0.2
C	140 (36.8%)	64 (27.4%)	1.6	204 (33.4%)	143 (41.2%)	107 (43.8%)	...	250 (42.3%)	0.1
D	5 (1.3%)	7 (3.0%)	16.2	12 (2.0%)	4 (1.2%)	3 (1.2%)	...	7 (1.2%)	27.1
TOTAL	380	231		611	347	244		591	

^a Probability for differences between all males and all females.

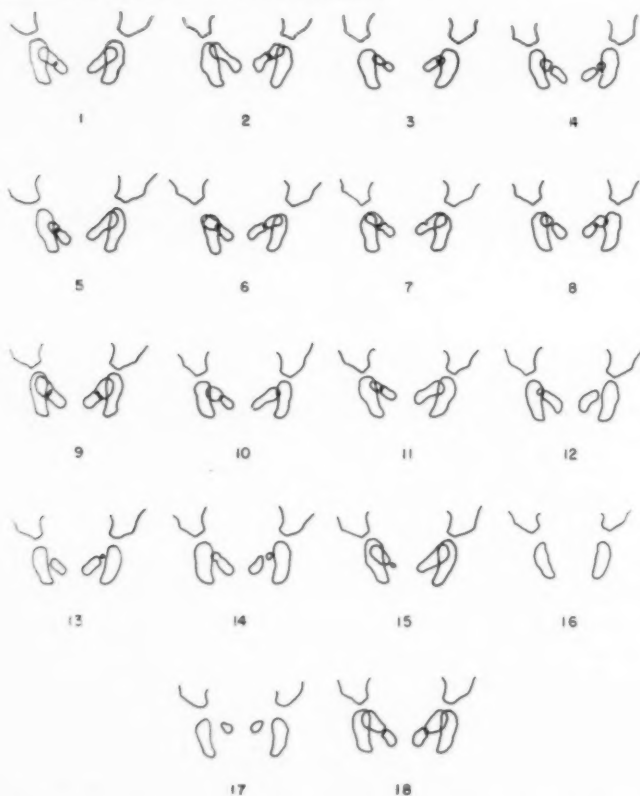


Fig. 3. Eighteen varieties of double ossification centers in the pubic rami.

pubic bone was least advanced at one year in those infants who had exhibited the most primitive ossification at birth.

Multiple ossification centers were found several times—in 20 of the series of 1,286 infants. The most common radiologic manifestation of a double ossification center (Fig. 3) was a radiolucent strip which

passed vertically through the approximate center of the superior ramus and separated it into two ossification centers. In several cases, follow-up studies disclosed that, with advancing age, this radiolucent zone filled in, and at the same time the margins of the contiguous bone became sclerotic. This radiologic image re-

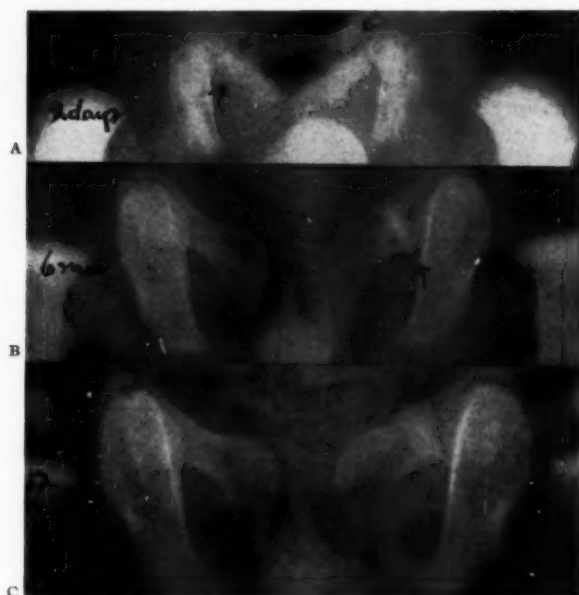


Fig. 4. Radiographic appearance of double pubic ossification centers. A. Two days. B. Six months. C. Twelve months.

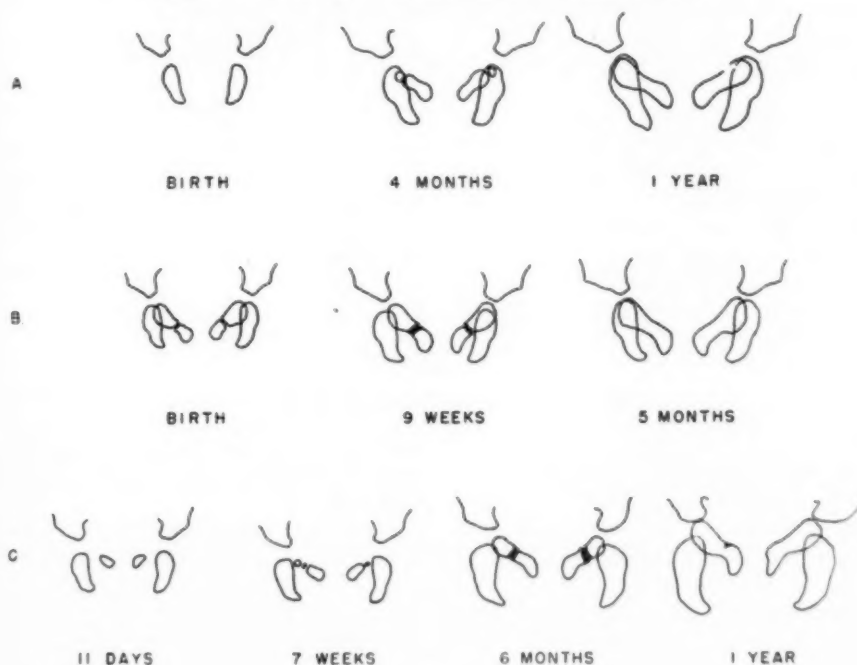


Fig. 5. Progressive changes in pubic bones with double ossification centers. A. In a premature infant with no pubic ossification centers at birth. B. In a full-term infant with double ossification centers in each pubic bone at birth. At nine weeks, the radiolucent strip is still present but the marginal bone has become sclerotic. At five months, the pubic bones are normal. C. A single small center in each pubic bone, at the junction of the two rami, on the eleventh day of life. At seven weeks, there are three pubic ossification centers in the right side of the pelvis and two on the left side. At six months, there is a single transverse radiolucent strip with marginal sclerosis in each superior ramus.

sembled a fracture line (Figs. 4 and 5).

In a few cases irregular ossification of the pubic bone produced other patterns. In one case there was a large center in the lateral portion of the body of the pubic bone and a separate smaller one in the superior ramus (Fig. 3, 15). In several, the converse was found: the medial center was the smaller (Fig. 3, 12, 13, 14). One newborn infant had three distinct centers in one pubic bone and two in the other (Fig. 5-C). The strip of sclerosis at the site of fusion of two pubic centers was still dense on one patient as late as the twelfth month (Fig. 4). In one infant sclerotic zones bordering an intermediate radiolucent strip were present at six months in a pubic ramus which had had no radiolucent strip at birth (not included in this report). Clinical signs were normal at birth and at six months. It is likely that the radiolucent zone, if present at birth, was obscured on the early film because it was not axial to the central x-ray beam.

SUMMARY

1. The results of a roentgen study of the pelves of 1,286 unselected newborn infants are presented.

2. In 53 per cent of full-term infants, the ossification center for the pubic bone appears as a horizontal strip in the superior ramus, with globular expansions laterad

in the body of the pubis and mediad at the junction of horizontal and descending rami. In 9 per cent ossification is less advanced than the model type (*Type B*), and in 38 per cent it is more advanced.

3. In 1.6 per cent of the 1,286 infants more than one ossification center was present on one or both sides. As ossification progressed, the narrow cleft between the two centers simulated a fracture line.

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SUMARIO

Osificación de los Huesos Pubianos en el Nacimiento

Ofrécense los resultados de un estudio roentgenológico de las pelvis de 1,286 recién nacidos tomados al azar.

En 53 por ciento de los lactantes a término, el centro de osificación para el pubis aparece en forma de tira horizontal en la rama superior, con expansiones globulares hacia los lados en el cuerpo del pubis y hacia el medio en la unión de las ramas

horizontal y descendente; en 9 por ciento, la osificación está menos, y en 38 por ciento, más avanzada.

En 1.6 por ciento de los 1,286 lactantes, había más de un centro de osificación en uno o ambos lados. A medida que avanzaba la osificación, la estrecha hendidura entre los dos centros simulaba una línea de fractura.

Paraphyseal or Colloid Cysts of the Third Ventricle¹

HARRY W. SLADE, M.D., NORMAN M. GLAZER, M.D., and HARRY HAUSER, M.D.

TO MOST PHYSICIANS neuropathology is an enigma both during their undergraduate and postgraduate days. It is only when entities are clinically recognized by means of so-called characteristic syndromes that the pathological features take on meaning. The presence of intermittent

Many of these were coroner's cases—death having been sudden and unexplainable. The first successful removal of a paraphyseal cyst was accomplished by Dandy in 1921 (2). Since that time, the number of operative removals has steadily increased.

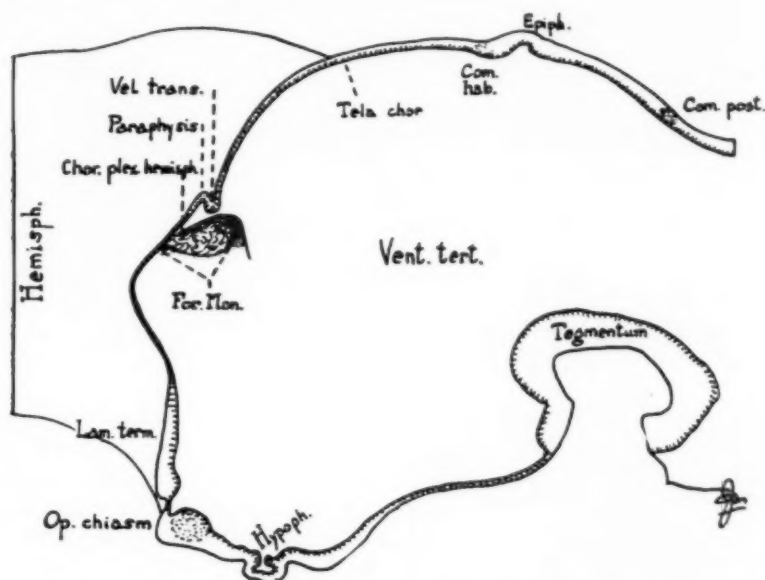


Fig. 1. Drawing from a wax reproduction of a 19-mm. human embryo, demonstrating the normal relationship of the paraphysis to the foramen of Monro. From McLean, A. J.: *Arch. Neurol. & Psychiat.* 36:485, September 1936.

symptoms of increased intracranial pressure without localizing evidence has been considered characteristic of anterior third ventricular tumors, of which the most commonly encountered is the colloid or paraphyseal cyst.

The first case of colloid or paraphyseal cyst of the third ventricle was reported by Wallman in 1858 (1). Up to the present time, reports of 119 cases have appeared in the literature. The vast majority of the early cases were discovered at autopsy.

EMBRYOLOGY

The paraphyseal origin of these cystic tumors was first suggested by Sjövall in 1909 (3). The paraphysis is a glandular structure found in some of the lower vertebrates, arising just behind the intervertebral foramen (Monro), as an evagination in the mid-line from the roof of the third ventricle (Fig. 1). In the human embryo, it makes its appearance at about the seventy-fifth day of gestation (20 mm.) and normally disappears shortly there-

¹ From the Departments of Neurosurgery and Radiology, Cleveland City Hospital, Western Reserve University School of Medicine, Cleveland, Ohio. Presented at the Forty-first Annual Meeting of The Radiological Society of North America, Chicago, Ill., Dec. 11-16, 1955.

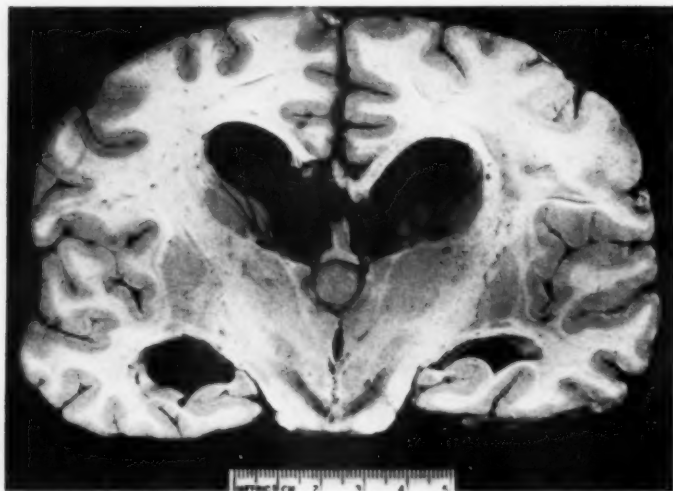


Fig. 2. Coronal section demonstrating the usual relationship of the tumor to surrounding structures. Note the mid-line position of the rounded tumor obstructing both interventricular foramina. (Courtesy of St. Alexis Hospital, Cleveland, Ohio.)



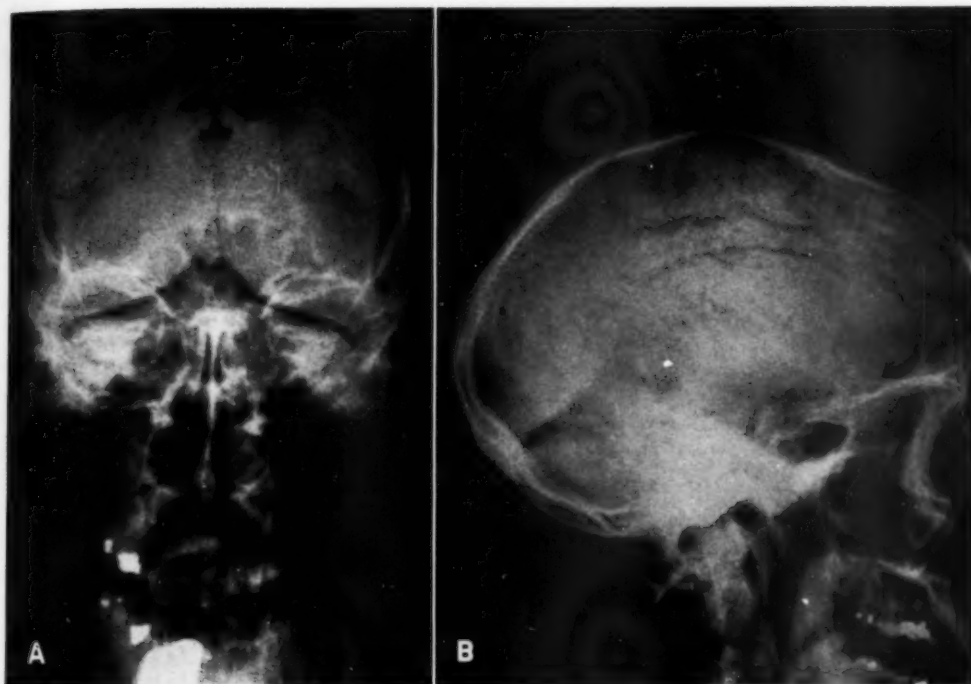
Fig. 3. Low-power ($\times 5$) magnification of a section of the cyst wall.

Note the thickness of the wall and, in this case, the presence of squamous epithelium. Many blood vessels are identified.

after (4, 5). In some individuals, remnants of the gland persist and slowly enlarge, presumably by retention of products of the secreting epithelial cells (6). As the structure grows, it projects downward into the third ventricle and, to a varying extent, upward and forward. As it starts downward, it is enfolded by layers of the tela, which explains the belief of some observers (7, 8, 9) that the cyst is an outgrowth of the tela and should thus be called a cyst of the choroid plexus. This concept, however, is still a matter of debate among neuropathologists.

SIGNS AND SYMPTOMS

Although a parapyseal cyst of the third ventricle is a benign lesion, the sudden impaction of both interventricular foramina can result in sudden death. Symptoms have included visual difficulties, fainting spells, dizziness, staggering, weakness in the arms and legs, headaches, nausea, and vomiting. Objectively, these patients may show little or no abnormality. On the other hand, papilledema or optic atrophy may occur. Questionable cerebellar signs have been present but, after closer examination, these can generally be



attributed to lesions in other pathways. Many of the patients also exhibit personality changes. The sudden intermittent character of the symptoms has often led to a diagnosis of psychoneurosis.

PATHOLOGY (Figs. 2 and 3)

The paraphyseal cyst of the third ventricle is a smooth-walled, pearl-gray, cystic structure of varying size. Microscopically, the outer layer of the cyst wall is composed of fibrous tissue, which may be somewhat vascular. The walls vary considerably in thickness, from those described as "thin" to those measuring approximately 2.5 mm. The external surface of the cyst may be covered by a single layer of low non-ciliated cuboidal cells. The inner layer may contain glandular structures, in which goblet cells are present, or it may be totally devoid of a glandular element (8, 10). The contents also vary, from a mucinous substance to a clear colorless fluid.



Fig. 4. Case I. A and B. Pneumoencephalograms illustrating failure of filling of the ventricular system. The callosal and cingulate sulci are elevated and rounded. Air is noted in the cisterna magna. Subtentorial air is prominent.

C. Ventriculogram showing dilatation of both lateral ventricles without air in the third ventricle. The soft-tissue density of the cyst is outlined, extending toward the floor of both lateral ventricles anteriorly. (Courtesy of Cleveland Clinic.)

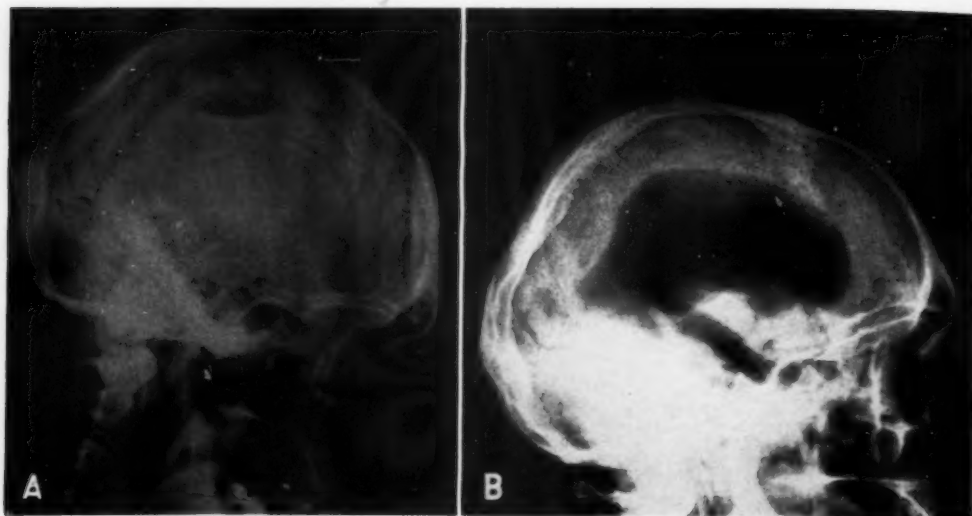


Fig. 5. Case II. A. Pneumoencephalogram showing partial filling of the lateral ventricles. The callosal and cingulate sulci are elevated and rounded.
B. Ventriculogram showing dilatation of the lateral ventricles. A soft-tissue density is outlined in the region of the anterior third ventricle. (Courtesy of Cleveland Clinic, Cleveland, Ohio.)

RADIOLOGY

Plain roentgenography of the skull usually reveals no abnormality or atrophic changes of the dorsum sellae and/or the posterior clinoid processes. Atrophic changes, when they do occur, are secondary to increased intracranial pressure. Plain films should always be taken, since unexpected findings such as calcification may be of differential diagnostic value.

At the present time, accurate preoperative diagnosis depends primarily on air and contrast studies. The recommended ventriculographic technic includes preliminary anteroposterior, half axial, and horizontal-ray lateral views (11). Because of the location of the cyst at the roof of the third ventricle, at the level of the foramina of Monro, many appearances are possible, depending on the degree of obstruction. These include: (a) dilatation of the lateral ventricles, with absence of air in the third ventricle; (b) dilatation of the lateral ventricles with a bulge in the floor of the third ventricle and absence of air in that structure; (c) dilatation of the lateral ventricles and of the foramina of Monro, with a filling defect in the anterior portion of the third ventricle; (d) dilata-

tion of the ipsilateral ventricle by occlusion of only one foramen of Monro, with no passage of air from one lateral ventricle to the other or to the third ventricle, and without visualization of the third ventricle; (e) symmetrical dilatation of the lateral ventricles, which have been filled from one side alone, with absence of the shadow of the septum pellucidum; (f) dilatation of both lateral ventricles, with bulging of the septum pellucidum to one side; (g) filling of the cyst with air during pneumoencephalography.

CASE REPORTS

CASE I: F. C., a 42-year-old white male, was admitted to the hospital because of blind spells, fainting, dizziness, headaches, and weakness of the legs and arms. He had been discharged from the Navy in 1944, because of psychoneurosis. From 1944 to 1946, he was "nervous" and experienced brief episodes of vertigo with generalized headaches, which usually occurred at work and disappeared upon his return home. Neurologic examination revealed bilateral papilledema with fresh hemorrhages in the right eye. The impression was that of a deep right frontal tumor.

The pneumoencephalographic appearance was thought to be characteristic of a posterior fossa lesion, although air was readily identified in the cisterna magna (Fig. 4, A and B). A suboccipital craniectomy performed on Dec. 23, 1946, revealed

no lesion in the posterior fossa. Ventriculography (Fig. 4C) was done on Dec. 30, followed by a right frontal craniotomy and removal of a 1-cm. paraphyseal cyst of the third ventricle.

CASE II: M. N., a 40-year-old bartender, was admitted to the hospital on Nov. 26, 1954, with a history of transient dizzy spells of one and one-half years duration. These spells usually occurred after he rose from a sitting position. The symptoms cleared five months after onset, only to recur with increased severity three months prior to admission. Neurologic examination demonstrated bilateral papilledema. Auditory acuity was diminished in the left ear. Lumbar puncture revealed an initial pressure of 220 mm. of water. A pneumoencephalogram and ventriculogram were obtained (Fig. 5, A and B), followed by craniotomy on Jan. 19, with removal of a paraphyseal cyst.

CASE III: L. P., a 13-year-old white female, was admitted to the hospital on May 6, 1946, with a history of headache, vomiting, and staggering for one year. Visual acuity had decreased. Neurologic examination revealed bilateral papilledema, and

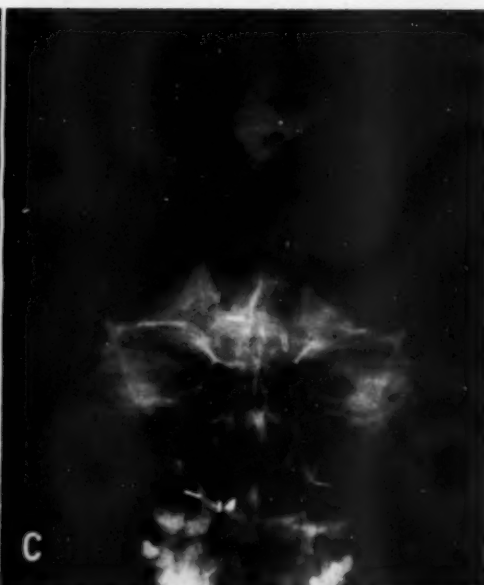
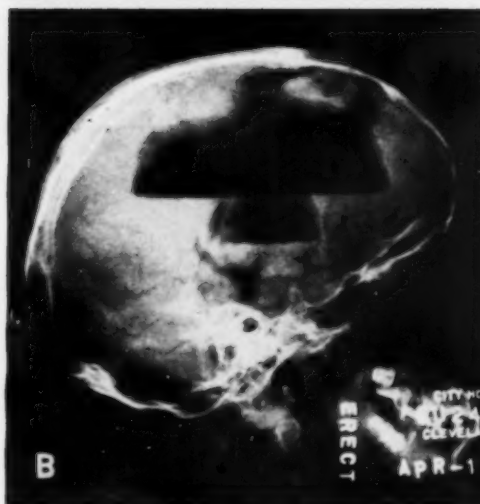
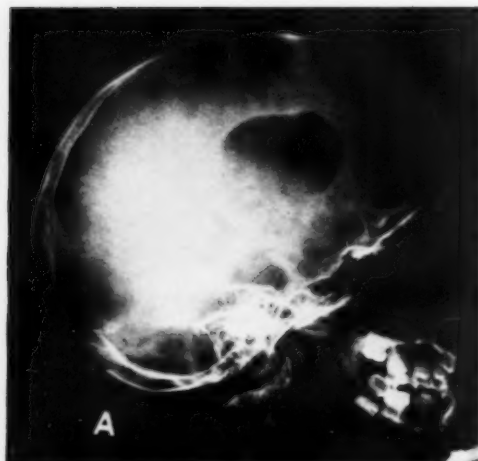


Fig. 6. Case III. A. Ventriculogram revealing dilatation of lateral ventricles and absence of air in the third ventricle. A soft-tissue mass is present between the separated anterior lateral ventricles. Note the bowing of the septum pellucidum. (Courtesy of University Hospitals, Cleveland, Ohio.)

B and C. Ventriculograms showing dilatation of the lateral ventricles. A soft-tissue mass is identified in the anterior third ventricle. Note evidence of suboccipital craniectomy. (Courtesy of University Hospitals, Cleveland, Ohio.)

adiadochokinesia of the left hand was present. A ventriculogram was interpreted as indicating a posterior fossa lesion (Fig. 6A), but findings on suboccipital craniectomy were negative. Between 1946 and 1954, the headaches and staggering occurred at

infrequent intervals. In May of the latter year the headaches became very severe and the patient was readmitted to the hospital. Ventriculography was done (Fig. 6, B and C) followed by craniotomy, with removal of a paraphyseal cyst.



ther pneumographic studies (Fig. 7, B and C), on April 26, a large parafyseal cyst of the third ventricle was removed (12) by way of a right frontal transcortical incision.

CASE V: L. G., a 52-year-old white male, entered the hospital on Dec. 8, 1954, with a history of lethargy, disorientation, and weakness. The patient had been known as a mental defective since the age of two years. During hospitalization (City Hospital) in 1952 a pneumoencephalogram (Fig. 8, A and B) had revealed a marked internal hydrocephalus, which was thought to be congenital in origin. (On these studies, the cyst had actually been filled with fluid and air, but was not recognized.) On the present admission (1954), pneumoventriculography (Fig. 8, C and D) was repeated, and the cyst itself was demonstrated, filled with fluid and air; it was thought to be a parafyseal cyst. On Dec. 27, it was removed.



Fig. 7. Case IV. A. Pneumoencephalogram indicating air in an unidentified area. (Courtesy of University Hospital, Columbus, Ohio.)

B and C. Ventriculograms showing dilatation of the lateral ventricles. A cystic mass is now filled in the erect position with air and fluid.

From Slade and Glazer: *Am. J. Surg.* 91: 431, May 1956.

CASE IV: J. P., a 14-year-old boy, gave a history of blurring of vision of three years duration. In 1948, he had been struck by an auto. In 1950, he showed marked behavior changes. Several psychiatrists were consulted but no therapy was suggested. In 1952, examination in another hospital revealed optic atrophy. Pneumography was performed (Fig. 7A), and a transfrontal craniotomy was carried out on Sept. 30, at which time a cyst was drained. Headaches and poor vision persisted, however, and in March 1954, because of the visual disturbance, the patient was referred to Cleveland City Hospital by his school physician. Neurologic examination again revealed primary optic atrophy. After fur-

DISCUSSION

As previously noted, radiologic studies are of the greatest importance in localizing anterior third ventricular tumors. Radiographic evidence of a parafyseal cyst varies greatly. To the characteristics mentioned by other authors, it is desired to add another diagnostic finding: the cyst itself may fill during pneumoencephalography and be recognized by its position and configuration. Competent

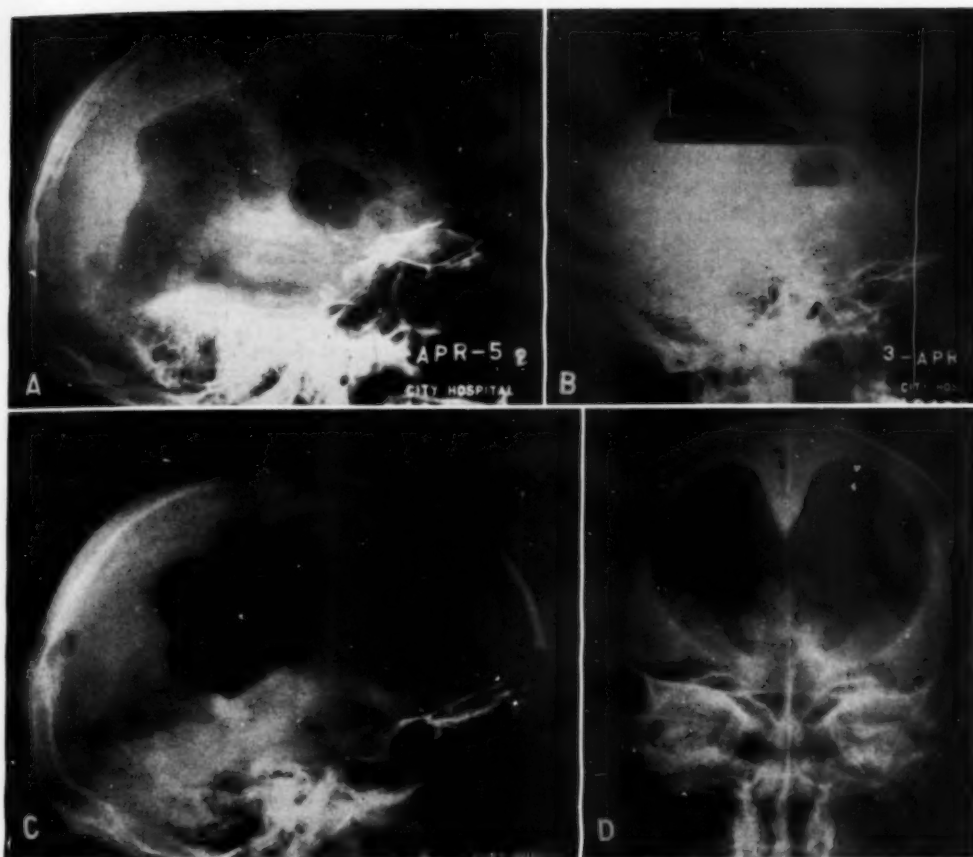


Fig. 8. Case V. A and B. Pneumoencephalograms showing dilatation of the lateral ventricles and the air-filled "cyst." The latter is not the third ventricle, with which it was confused. C and D. Ventriculoencephalograms showing dilatation of the lateral ventricle as well as air in the third ventricle. A soft-tissue mass is apparent in the anterior third ventricle.

radiologists and neurosurgeons have failed to interpret this appearance correctly and have confused the air-filled cyst with a dilated third ventricle secondary to hydrocephalus. That such an error in interpretation is probably not a unique experience is indicated by its occurrence in 2 cases seen in one hospital within nine months.

The question arises as to the mechanism whereby air gains entrance to the cyst during pneumoencephalography. A definite answer cannot be given. One possible explanation is that previous cranial trauma may have caused a rent in the wall of the cyst, thus permitting communication with the ventricular system. Another, less likely possibility is perforation as a result

of long-standing increased pressure within the lateral ventricles. In support of this latter explanation is a reported case of rupture of the cyst into the brain (13). It has been stated that with increased intracranial pressure of long standing, perforation may occur in the septum pellucidum.

The differential diagnosis of anterior third ventricular tumors originating near or extending into the region of the foramina of Monro should take into consideration papillomas, ependymomas, astrocytomas, pinealomas, intraventricular adamantinomas, intraventricular epidermoids, and cystic polar spongioblastomas. Meningiomas, craniopharyngiomas, suprasel-

lar extensions of pituitary adenomas, gliomas, and tumors of the basal ganglia may invaginate into the third ventricle but are unlikely to extend to the foramina of Monro (14). None of the aforementioned lesions have been reported to communicate with the lateral ventricles in the region of the third ventricle and to present on pneumoencephalography as an air-filled "cyst." This new sign of colloid cyst may thus be considered pathognomonic.

SUMMARY

The paraphyseal or colloid cyst is the most common lesion of the anterior third ventricle. Its origin from the paraphysis has been discussed. The radiologic criteria for the diagnosis are varied, depending upon the degree of obstruction at the foramina of Monro. A new sign is described, namely, filling of the cyst itself during pneumoencephalography.

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SUMARIO

Quistes Parafisarios o Coloideos del Tercer Ventrículo

Preséntase aquí una reseña del quiste parafisario o coloideo del tercer ventrículo, describiéndose 5 casos, en todos los cuales ayudaron en el diagnóstico estudios ventriculográficos y/o neumográficos. Menciónase un nuevo signo radiográfico, a saber, el henchimiento del quiste mismo durante la pneumoencefalografía.

La técnica ventriculográfica recomendada comprende vistas preliminares anteroposteriores, hemiaxiales, y laterales con rayos horizontales. Las pautas radiológicas para diagnóstico dependen del grado de oclusión de los agujeros de Monro, comprendiendo, además del precitado signo: (a) dilatación de los ventrículos laterales, con falta de aire en el tercer

ventrículo; (b) dilatación de los ventrículos laterales con abultamiento en el suelo del tercer ventrículo y falta de aire en éste; (c) dilatación de los ventrículos laterales y de los agujeros de Monro, con nicho en la porción anterior del tercer ventrículo; (d) dilatación del ventrículo ipsilateral por oclusión de un agujero de Monro, sin pase de aire ya de un ventrículo lateral al otro o al tercer ventrículo, y sin visualización del último; (e) dilatación simétrica de los ventrículos laterales que no se han henchido más que de un lado, con falta de la sombra del tabique pelúcido; (f) dilatación de ambos ventrículos laterales, con abultamiento del tabique pelúcido hacia un lado.

Positioning of Pelvic Portals for External Irradiation in Carcinoma of the Uterine Cervix¹

GILBERT H. FLETCHER, M.D., and ROBERTO CALDERON, M.D.

THE TOLERANCE of tissues to radiation is an inverse function of the volume irradiated. Portals should be no larger than necessary to cover the tumor-bearing areas. The widespread practice of using four or even six 15 × 10-cm. portals in the external irradiation of carcinoma of the cervix with medium voltage (200 to 400 kv) irradiates a large volume of tissue unnecessarily. Delivering high doses to such large areas increases the incidence of severe complications, and eventually lowers the cure rate (2, 7, 12). The availability of multimillion-volt therapy renders integrated planning and accurate aiming to secure minimal but adequate coverage of the tumor-bearing areas most imperative.

Arrangement of the pelvic portals depends upon the purpose to be achieved: whether treatment of the primary tumor and its extensions or treatment of the lateral aspects of the parametria and lymph nodes only, as a supplement to local irradiation by intracavitary radium (5). For the former, the whole pelvis is included; for the latter, only a slab of tissue covering the lateral aspects of the parametria and the pelvic wall. If medium-voltage therapy is used as a supplement to intracavitary radium therapy, the treatment should be limited to the pelvic wall nodes. If larger volumes are irradiated, to include the common iliac nodes, the tumor dose has to be lowered below effective levels.

Supervoltage therapy, with or without rotation and megavoltage therapy (betatrons and linear accelerators), makes it possible to deliver very high doses to larger volumes of tissue, with satisfactory tolerance during treatment. It brings about the possibility of a radical departure in the planning of treatment of squamous-cell carcinomas of the uterine cervix. The

classical handling of the primary lesion with well performed intracavitary radium therapy or transvaginal therapy with moderate supplementary irradiation to the lateral aspects of the parametria and pelvic wall nodes yields high cure rates, with a low incidence of complication, in Stage I and early Stage II carcinoma. The management of late Stage II, Stage III, and Stage IV lesions, and some clinical varieties of Stage I, is much less satisfactory, failure being attributable in many instances to lack of control of the disease within the pelvis or in the nodes along the common iliac vessels. It is in this latter group that the practice of primary radium therapy supplemented by external irradiation can be reversed by irradiating the whole pelvis and part of the common iliac nodes with high doses and supplementing the treatment of the primary by much reduced intracavitary radium or transvaginal therapy.

In the M. D. Anderson Hospital, the practice of taking films with the therapy unit in actual treatment position in order to check the position of the pelvic portals, has taught us that individual variations in the tilt of the pelvis preclude the use of the same surface landmarks, even bony ones, on every patient. Neither the symphysis anteriorly nor the anal margin or sacrococcygeal joint posteriorly can be used routinely as landmarks for the lower margin of the portals.

ANATOMICAL RELATIONSHIPS

In the planning of external beam therapy, the anatomical structures of most significance can be divided into two groups. The first group includes the vagina, the cervix, the paracervical tissues, the body of the uterus, and the medial aspects of the broad and uterosacral ligaments. The

¹ From the University of Texas, M. D. Anderson Hospital, Houston, Texas. Accepted for publication in September 1955.

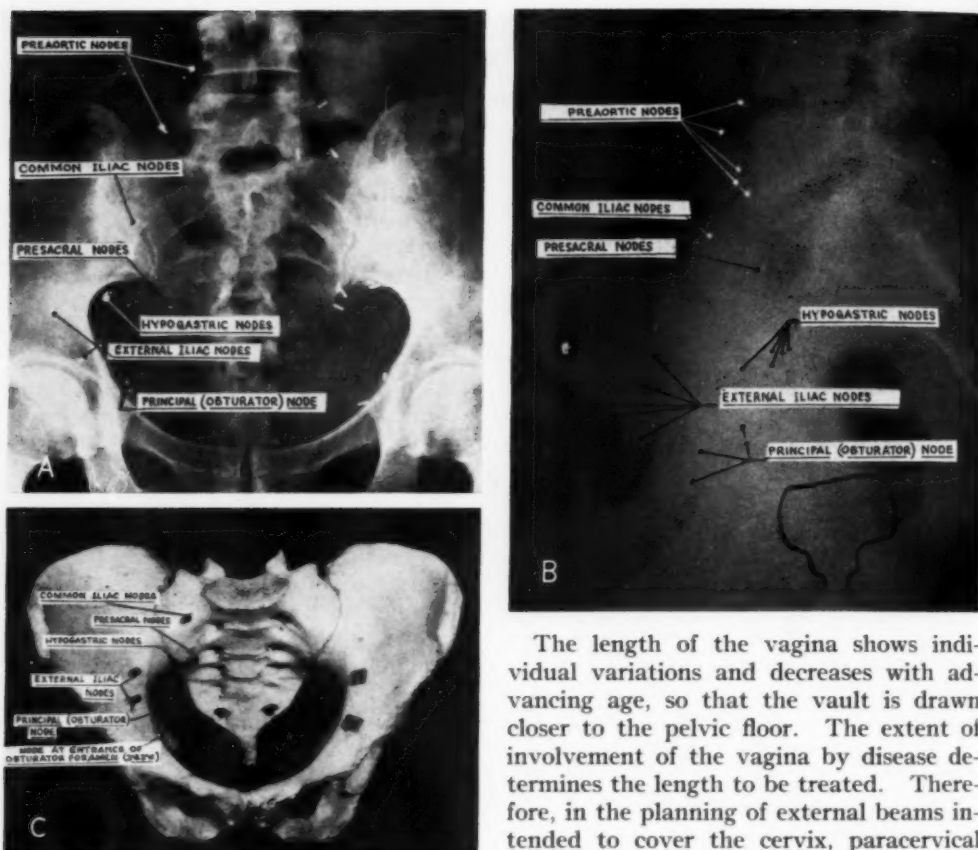


Fig. 1. A. Anteroposterior film of pelvis showing the position of pelvic lymph nodes. Lymph node locations have been identified by metallic clips during lymphadenectomy. The colpostats have been traced in the same position to the bony pelvis as they were on the films taken with the applicators *in situ*.

B. Lateral film of pelvis of same patient. Due to a small senile vagina, the vaginal applicators are low in relationship to the nodes.

C. Dry pelvis with pins located at the position of the lymph nodes as determined from the x-ray films.

second group is comprised of the lateral aspects of the broad and uterosacral ligaments, and the pelvic wall nodes. This distinction is important, since the second group has a fixed and fairly consistent relationship to the bony pelvis, whereas for the first group this relationship varies considerably. The tilt of the pelvis in the prone and supine positions changes with the individual, contributing further to the inconstancy of the relationship between the bony pelvis and the surface landmarks.

The length of the vagina shows individual variations and decreases with advancing age, so that the vault is drawn closer to the pelvic floor. The extent of involvement of the vagina by disease determines the length to be treated. Therefore, in the planning of external beams intended to cover the cervix, paracervical areas, and the diseased portion of the vagina, a method of projecting these structures on the anterior and posterior surfaces of the pelvis must be devised.

The location of the pelvic nodes has been well established (8-11, 13, 14). As indicated above, they maintain a fairly constant relationship with the bony pelvis. The principal node (called also the obturator node), one of the most constant in position, as well as one of the most frequently involved by squamous-cell carcinoma of the cervix, lies against the pelvic wall, slightly higher than the center of the acetabulum. The hypogastric group is located in the vicinity of the bifurcation of the common iliac into the external iliac and hypogastric arteries, about 4 to 5 cm. posterior to the obturator node. The node located at the entrance of the obturator foramen is seldom found. The

external iliac artery group spreads along the pelvic inlet, mainly in the middle third. The sacral nodes, although surgically inaccessible, have been proved to lie anterior to the second or third segments. The common iliac artery group, which is an extension of the hypogastric group, starts in front of the sacral wing and extends as high as L-5, joining the nodes of the bifurcation of the aorta at that level (Fig. 1).

The node areas and the lateral aspects of the broad and uterosacral ligaments included in the treatment beam are checked with films taken in treatment position, by identifying the parts of the bony pelvis known to be adjacent to them (Figs. 3-6).

TECHNIC

The projection of the cervix on the anterior and posterior surfaces of the body can be determined by using a double arm caliper, constructed with one removable graduated arm (Fig. 2). The rod is carefully placed against the cervix, with the aid of the examining finger, and is left in the vagina while films are taken with the therapy machine under strict treatment conditions, including compression. The central lead strip is omitted so that the lead plug and the brass rings engraved in the rod may be visualized. The number of rings seen on the films indicates the number of centimeters of the vagina included in the beam, and a correction is made if the length of the vaginal sheath involved by disease is not adequately covered.

The radiographic technics for conventional x-ray therapy machines have been well described by several authors (1, 3). With the cobalt-60 unit, medical x-ray films in ordinary cardboard cassettes (lead screen up) are used, and developed as for diagnostic procedures. It has been found that about one roentgen to the film gives the best bony definition. Taking into consideration the source-film distance and the output of the unit, exposure times can be determined for various patient thicknesses. The bony detail is not as good as at the 250-kv range, but the pelvic structures are easily identified.

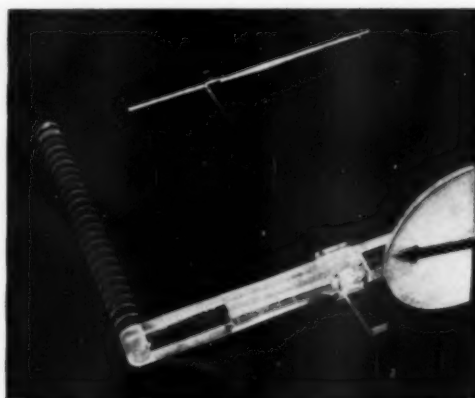


Fig. 2. Cervical caliper. The detachable arm of the caliper is a plastic cylinder with metal rings engraved in grooves at intervals of 1.0 cm., and a small lead piece at the tip. The other arm has two degrees of freedom, scaled in centimeters. A sliding graduated rod located at the tip is in line with the tip of the plastic cylinder when on the zero position of the horizontal scale. The protractor arrow moves freely on a ball-bearing joint. The plastic arm is introduced into the vagina, guided by the examining finger, until contact is made with the vault. The depths of the fornices and length of vagina involved by disease are measured by pelvic examination. While films are taken for checking of positioning of the portals, the plastic rod with the metal rings is left in place. One can see on the film the position of the cervix and determine by the number of rings the length of vagina within the beam. The lower margin of the field can be corrected to include enough rings to obtain adequate coverage. This is especially useful when there is invasion of the vaginal walls. To determine the angle of oblique fields, the caliper is rotated until the metal rod points to the center of the field and the angle is then read on the protractor.

Compression cones are always used, even with the cobalt-60 unit, and the 22-MEV betatron. The anteroposterior diameter of the patient is measured from the middle of the cone to the top of the treatment table. The exposure is made with compression fully applied.

WHOLE PELVIS IRRADIATION

If a bulky, infected, or crater-type tumor is present, or if there is considerable anatomical distortion which precludes a minimum of optimal geometry of the radium sources, external irradiation is delivered first to shrink the mass or clear the infection. A volume distribution which spares the rectum and bladder as much as possible and does not produce a maximum on the mid-line is preferable, as high doses to the primary disease in the cervix, vault,

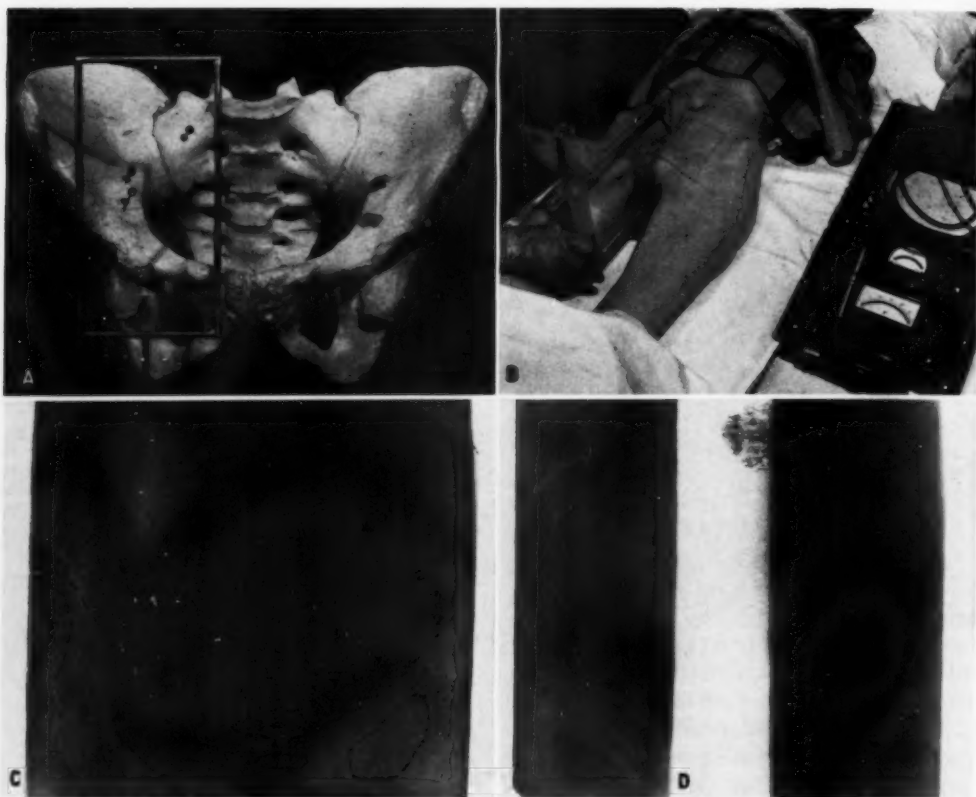


Fig. 3. A. Dry pelvis photographed with frame duplicating an anterior portal 12×6 cm., 2 cm. from the mid-line. There is generous coverage of the pelvic wall and node groups. The lower edge of the field must transect the obturator foramen. The extent of lumbosacral structures included varies with the tilt of the pelvis.

B. Patient with the "cervical localizer" in use. The projection of the cervix on the anterior abdominal wall is determined by the vaginal caliper. A 14×15 -cm. field is marked, with the lower margin at mid-thickness of the symphysis. The portal is divided by a central lead strip into two fields. At the right of the picture is a direct-reading meter with which readings were taken with the ionization chamber against the cervix.

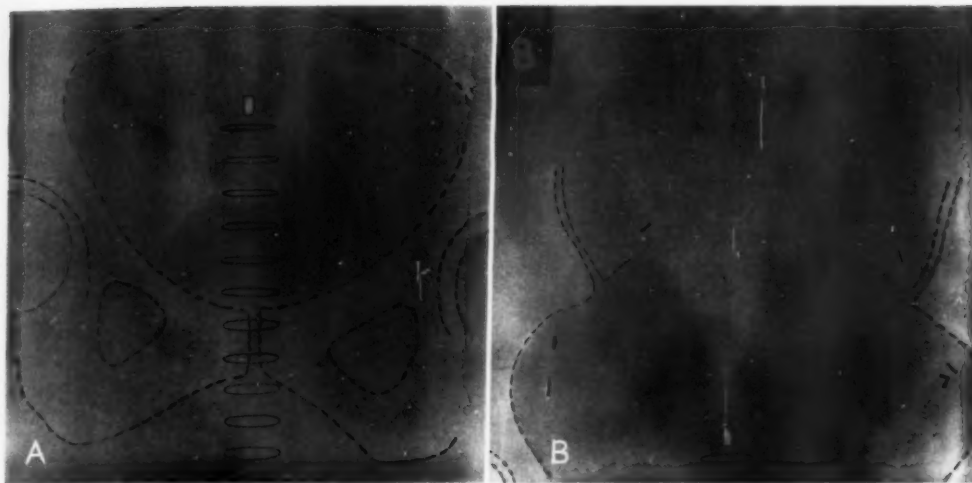
C. Film of anterior portal, 14×15 cm., taken with the therapy machine in actual treatment position, to check accuracy of position along axis of the body. The central lead strip was omitted, to allow visualization of the rod. Due to the large portal, there was less sharpness of detail, making it necessary to retouch the prints, but the diagnostic quality of the film is sufficient for identification of the bony structures and for counting the metal rings. In this instance the portal is too low and the field was moved 2 cm. cephalad.

D. Same portal after correction. The central lead strip has been used in taking this film. Sharpness of detail is good. The coverage of the parametrial tissues and the pelvic lymph nodes is satisfactory. This patient had a lymphadenectomy and the position of the lymph nodes has been marked by metallic clips, which can be seen. Observe that the lower margin of the field includes the upper part of the obturator foramen and correlate this with the dry pelvis.

and paracervical triangle will be attained by radium or transvaginal therapy.

A satisfactory distribution was obtained by use of an anterior split field slightly tilted to the feet and two posterior oblique portals traversing the sciatic notches. The distance from the sacral ridge to the medial margin of the posterior portals is 4 to 5 cm., and the medial tilt 25 to 30° .

In the average patient, a height of 12 cm. for the anterior split field adequately covers the pelvic wall nodes, including part of the common iliac group (Fig. 3). In unusually large pelves, and more so in the patient whose pelvis is tilted anteriorly in the supine position, 14 cm. height is necessary to cover most of the sacroiliac joint, *i.e.*, to assure coverage of the hypogastric nodes. These nodes are so fre-



quently involved that, if external irradiation is to have any meaning, they must be included.

If one has chosen the supervoltage high-dose total pelvic technic for late stages, then coverage of part of the common iliac nodes is warranted as one delivers doses to the node areas which are cancerocidal. In that instance, portals 15 cm. high should be used.

A total width of 15 cm. is adequate to cover the pelvic walls laterally. A central lead strip 2 cm. wide is used, producing about 3 cm. geometrical screening at mid-pelvis in the average patient. The lower aspect of the portal is placed at mid-symphysis, and a film is exposed with the rod in the vagina, duplicating treatment conditions (lead strip omitted). The lymph-node areas are covered satisfactorily if the lower aspect of the film transects the obturator foramen above the lower ramus of the pubis. Most of the sacroiliac joint must be seen to insure coverage of the hypogastric nodes. If the film reveals that the field is too high or too low, corrections are made, usually 1 to 2 cm. in either direction (Fig. 3). Correction can also be made by changing by 5° the usual 10° tilt to the feet. It is surprising how a seemingly slight correction produces appreciable changes in the amount of bony structures seen. This is to be explained by

Fig. 4. A. Straight posterior portal (14 X 15 cm.) with lower margin at the level of the anal margin. It can easily be seen that the field is too low.

B. Straight posterior portal (14 X 15 cm.) with lower margin at the level of the sacrococcygeal joint. Here the field is too high, missing the lower part of the pelvis.

C. Straight posterior portal (14 X 15 cm.). The lower margin has been marked to include an adequate length of the vagina, with use of the caliper to project the cervix on the posterior surface of the body. The lower margin falls between the anal margin and the sacrococcygeal joint. The films are from different patients, illustrating individual variation in tilt of the pelvis.

the foreshortening resulting from the pelvic tilt.

There are no surface landmarks, including bony ones, which assure accurate

TABLE I: WHOLE PELVIS IRRADIATION. TISSUE DOSE FOR DIFFERENT PELVIC ANTEROPOSTERIOR DIAMETERS (MEASURED WITH COMPRESSION)

250 kv, Th. III Filter, 3.1 mm. Cu h.v.l.									
A + B. Anterior split field: 14 × 15 cm. at 70 cm. F.S.D. with center lead strip giving 2.3 cm. geometrical screening at 10 cm. depth									
C + D. Posterior field: 14 × 7 cm. at 70 cm. F.S.D. angulated 27° toward mid-line									
AP Diam.	→	16 cm.	17 cm.	18 cm.	19 cm.	20 cm.	21 cm.	22 cm.	23 cm.
Mid-line		A + B = 25 C + D = 70 TOTAL 95	A + B = 24 C + D = 68 TOTAL 92	A + B = 23.5 C + D = 64 TOTAL 87.5	A + B = 23 C + D = 61.5 TOTAL 84.5	A + B = 23 C + D = 60 TOTAL 83	A + B = 21.5 C + D = 57 TOTAL 78.5	A + B = 20.5 C + D = 54 TOTAL 74.5	A + B = 20 C + D = 51 TOTAL 71
2 cm. from mid-line		A + B = 49 C + D = 59 TOTAL 108	A + B = 45 C + D = 55 TOTAL 100	A + B = 42 C + D = 54 TOTAL 96	A + B = 39 C + D = 53 TOTAL 92	A + B = 38 C + D = 53 TOTAL 91	A + B = 34 C + D = 52 TOTAL 86	A + B = 32 C + D = 51 TOTAL 83	A + B = 30 C + D = 51 TOTAL 81
5 cm. from mid-line		A + B = 50 C + D = 58 TOTAL 108	A + B = 47 C + D = 53 TOTAL 100	A + B = 44 C + D = 50.5 TOTAL 94.5	A + B = 41.5 C + D = 48 TOTAL 89.5	A + B = 39 C + D = 45 TOTAL 84	A + B = 37 C + D = 42 TOTAL 79	A + B = 35 C + D = 42 TOTAL 77	A + B = 33 C + D = 39 TOTAL 72

Cobalt-60 Irradiation									
A + B. Anterior split field: 14 × 14 cm. at 60 S.S.D. with center lead block giving 4 cm. split at 10 cm. depth and 45° wedges, wedging 2 cm. of each field									
C + D. Posterior field: 14 × 8 cm. at 60 S.S.D., angulated 27° toward the mid-line									
AP Diam.	→	16 cm.	17 cm.	18 cm.	19 cm.	20 cm.	21 cm.	22 cm.	23 cm.
Mid-line		A + B = 5 C + D = 100 TOTAL 105	A + B = 5 C + D = 100 TOTAL 105	A + B = 5 C + D = 100 TOTAL 105	A + B = 5 C + D = 95 TOTAL 100	A + B = 5 C + D = 94 TOTAL 99	A + B = 5 C + D = 92 TOTAL 97	A + B = 5 C + D = 89 TOTAL 94	A + B = 5 C + D = 85 TOTAL 90
2 cm. from mid-line		A + B = 33 C + D = 70 TOTAL 103	A + B = 32 C + D = 70 TOTAL 102	A + B = 32 C + D = 70 TOTAL 102	A + B = 31 C + D = 70 TOTAL 101	A + B = 30 C + D = 74 TOTAL 104	A + B = 28 C + D = 77 TOTAL 105	A + B = 27 C + D = 78 TOTAL 105	A + B = 24 C + D = 78 TOTAL 102
5 cm. from mid-line		A + B = 56 C + D = 70 TOTAL 126	A + B = 54 C + D = 70 TOTAL 124	A + B = 53 C + D = 70 TOTAL 123	A + B = 51 C + D = 65 TOTAL 116	A + B = 49 C + D = 65 TOTAL 114	A + B = 47 C + D = 62 TOTAL 109	A + B = 46 C + D = 58 TOTAL 104	A + B = 45 C + D = 57 TOTAL 102

With this arrangement of portals the dose to the pelvic wall is higher than the dose to the mid-line. This is advantageous in conjunction with intracavitary radium or transvaginal therapy, as the mid-line dose can be carried by these methods to any desired level. This preferential tissue dose to the pelvic wall is even more marked with the cobalt-60 irradiator.

positioning of straight posterior or posterior oblique portals, as the tilt of the individual pelvis in the prone position is a major factor in determining the anatomy covered. If the anal margin is used as the lower border of the portal, a large amount of tissue is usually irradiated far below the necessary level (Fig. 4). If the frequently elusive sacrococcygeal joint is used, the cervix may be missed, or too short a length of vagina included.

The vaginal caliper allows accurate positioning of either straight posterior or posterior oblique portals. The projection of the cervix on the posterior surface of the

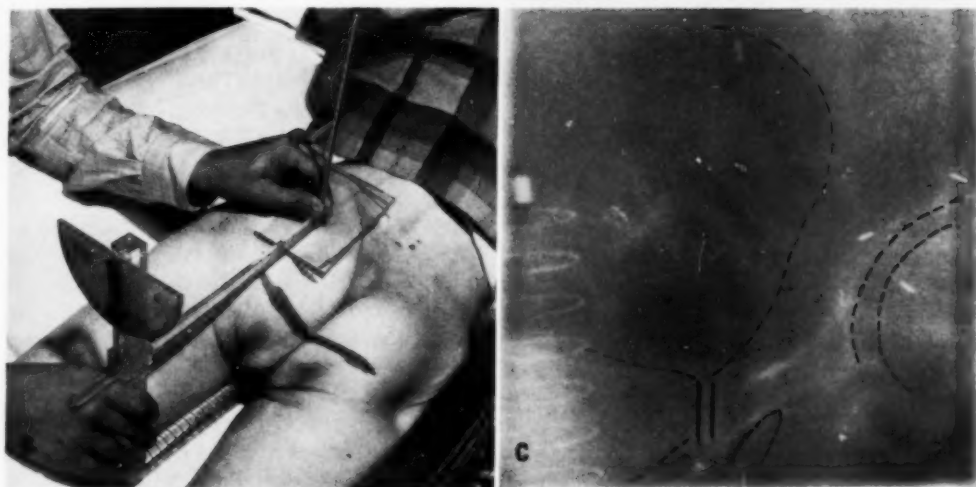


Fig. 5. A. Dry pelvis showing the coverage of a 14×7 -cm. portal with 27° angle toward the mid-line. The portal covers selectively the homolateral pelvic wall.

B. Patient with cervical localizer in place. After the position of the cervix has been found, the center of the portal is determined according to the clinical findings as to vaginal extension. The line drawn through the gluteal region goes through the anal margin, and it can be seen that it is too low as a lower margin for the posterior field. The posterior fields measure 14×7 cm. and are drawn on the skin with the aid of a plastic rectangle.

C. Film of the pelvis taken with the therapy machine in actual treatment position, at 27° angle to the mid-line. There is satisfactory coverage of the pelvic wall and lymph nodes (dural clips). The cervix, shown by the metal button at the end of the cervical localizer, lies almost at the edge of the field.

body is determined, and the lower margin of the portal marked according to the length of vagina involved by disease. If there is involvement of the cervix and fornices only, the lower margin is set 4 cm. below the projection of the cervix, to include the common iliac nodes as high up as possible. If the vagina is extensively involved, the lower margin is placed accordingly, and the adequacy of the field is checked by films taken with the vaginal

rod in position, counting the number of brass rings. Plastic rectangles are useful for drawing the posterior oblique portals in their correct positions. The angle of the line joining the center of the portal to the cervix in the sagittal plane is determined. This is usually around 35° . A medial tilt of 25 to 30° is preferable, however, as it covers the homolateral pelvic wall better. The medial tilt and the distance from the mid-line to the medial margin of the portal

TABLE II: PARALLEL OPPOSING SPLIT FIELDS. TISSUE DOSE IN THE PLANE AT MID-DISTANCE

AP Diam.	→	15 cm.	16 cm.	17 cm.	18 cm.	19 cm.	20 cm.	21 cm.	22 cm.	23 cm.	24 cm.	25 cm.
<i>250 kv x-ray, 14 × 15 cm., 70 cm. F.S.D., h.v.l. 3.1 mm. Cu, central screening 4 cm. width at 10 cm. depth</i>												
Under screened area	...	43	41	40	39	38	36	34	32	..	..	..
5 cm. off mid-line	...	98	92	85	81	76	70	65	60	..	..	..
<i>Cobalt-60, 14 × 14 cm., 60 cm. S.S.D., center screening 4 cm. width at 10 cm. depth</i>												
<i>Posterior and anterior field with 45° wedges (medial half only)</i>												
Mid-line	10	10	10	10	10	10	10	10	10	10	10	10
2 cm. off mid-line	70	68	66	64	62	59	56	53	50	47	44	41
5 cm. off mid-line	119	115	111	107	103	100	96	93	89	86	83	80
<i>Cobalt-60, 14 × 14 cm., 60 S.S.D., central screening 4 cm. width at 10 cm. depth</i>												
Mid-line	10	10	10	10	10	10	10	10	10	10	10	10
2 cm. and 5 cm. off mid-line	119	115	111	107	103	100	96	93	89	86	83	80

It is of interest to note that, due to side-scatter, about 50 per cent of the tissue dose to the pelvic wall reaches the mid-line tissues under the lead strip which absorbs 95 per cent of the primary beam. Screening of the mid-line is much more efficient with the cobalt-60 irradiator. The addition of wedge filters to the medial halves of the portals on each side of the central lead block provides a gradient dovetailing the volume distribution of the radium system.

are independent of the anteroposterior diameter, because these two parameters are related to the bony pelvis. Compression brings the medial aspect of the cone to the level of the sacral ridge. If the cervix is pulled laterally by old inflammatory disease or cancer, it is identified by the lead button only on the posterior oblique film of the side toward which the cervix is displaced. This has no particular significance in planning, as the tissue dose is almost homogeneous over the whole pelvis, being slightly less on the mid-line.

On the films taken for checking the position of the posterior oblique portals, the ischial spine and a foreshortened obturator foramen on the same side must be seen, as well as part of the acetabulum and head of the femur (Fig. 5). These bony structures give proof that the pelvic nodes and uterosacral ligaments, which are close to the ischial spine, are included. Posterior oblique portals give maximum contribution to the uterosacral ligaments, which receive little contribution from the radium. This is a significant advantage, as these structures have been shown to be more often involved than was previously supposed.

Tables giving the tissue dose on the mid-line and on the pelvic wall can easily be made for various thicknesses, with the anteroposterior diameter, measured after compression, as the parameter. Points of interest in the planning are found on the mid-line and 2 cm. and 5 cm. from the mid-

line, the last being located on the pelvic wall (Table I).

PLANNING FOR TREATMENT OF LATERAL ASPECTS OF PARAMETRIA, UTEROSACRAL LIGAMENTS, AND PELVIC WALL NODES

In combination with intracavitary radium therapy or with transvaginal therapy, the lateral aspects of the parametria, uterosacral ligaments, and pelvic wall nodes should be irradiated with minimum dosage to the mid-line. At the 200 to 400-kv range, however, about 50 per cent of the dose to the pelvic wall reaches the mid-line as a result of side scatter (Table II). With cobalt 60 (4) and the 22-MEV betatron, 90 per cent efficiency of the screening is obtained without inconvenience.

Two opposing portals, with a half-value layer of 3 mm. Cu and 70 cm. focus-skin distance, give appreciably less than 100 per cent of the skin dose at mid-pelvis except in thin patients, and are not practical for pelvic wall doses of more than 2,000 to 2,500 r. Two opposing portals with cobalt 60 and the same source-skin distance give close to 100 per cent with an anteroposterior diameter up to 21 cm. but produce a maximum dose (120 per cent) in the subcutaneous tissues (Table II).

The opposing portals can be separate narrow portals 12 to 14 cm. high, 5 to 6 cm. wide, with the inner margin 2 to 3 cm. from the mid-line, or one portal 15 cm. wide can be used with central lead blocks

of such width as to produce geometrical screening of 4 to 6 cm. at mid-pelvis. The depth dose on the pelvic wall and the scatter contribution to the mid-line are not appreciably affected by either technic.

Three parametrial portals: anterior, sacral, and gluteal, with a half-value layer of 3 mm. Cu and 70 cm. focus-skin distance, give 100 per cent depth dose with anteroposterior diameters up to 20 cm. (Table III). The skin doses and subcutaneous doses are less, as there is only partial overlapping of the entrance and exit beams.

The anterior portals contribute chiefly to the obturator, external, and common iliac nodes. They must be accurately integrated with the volume distribution of the radium system. The sacral and gluteal portals contribute to regions in which the radium system offers but little, *i.e.*, the hypogastric and common iliac nodes and the uterosacral ligaments. In order to dovetail the decreasing contribution of the radium with external irradiation, the width of the central lead strip is increased 1.0 cm. every 1,000 r pelvic wall dose. This applies primarily to the anterior portals. The original width of the central lead strip depends upon the total pelvic dose prior to radium therapy, the lateral throw-off from the radium system, and also the position of the radium within the pelvis, as the contribution to the pelvic wall nodes varies considerably with this (5, 6). If the vagina has lost its roominess and elasticity due to disease or old age, the radium system is too low, and the dose received by all the pelvic nodes is accordingly decreased. Point B, in such cases, is well below the level of the obturator node (6). If the radium system is high, point B may be superimposed on the obturator node.

The skin doses to the three portals can be weighted in order to compensate for the difference in contribution from the radium system to the various node groups. The sacral portals can be given more in order to build up the dose to the commonly involved hypogastric nodes and common

TABLE III: PARAMETRIAL EXTERNAL BEAM TECHNIC

AP Diam.	Field	250 Kv X-Rays		
		Thoraeus Filter III, 70 cm. F.S.D., h.v.l. 3.1 mm. Cu	Cobalt-60, 60 cm. S.S.D.	
		3:3:3 2,000	3:4:2 2,000	3:3:3 2,000
16 cm.	A	1,550	1,550	1,150
	S	1,550	2,100	1,150
	G	1,550	1,050	1,150
17 cm.	A	1,700	1,700	1,200
	S	1,700	2,200	1,200
	G	1,700	1,100	1,200
18 cm.	A	1,750	1,750	1,250
	S	1,750	2,350	1,250
	G	1,750	1,200	1,250
19 cm.	A	1,900	1,900	1,300
	S	1,900	2,500	1,300
	G	1,900	1,300	1,300
20 cm.	A	2,050	2,050	1,350
	S	2,050	2,700	1,350
	G	2,050	1,350	1,350
21 cm.	A	2,200	2,200	1,400
	S	2,200	2,900	1,400
	G	2,200	1,450	1,400
22 cm.	A	2,300	2,300	1,450
	S	2,300	3,100	1,450
	G	2,300	1,550	1,450
23 cm.	A	2,500	2,500	1,500
	S	2,500	3,350	1,500
	G	2,500	1,700	1,500

A. Anterior field, 14 × 15 cm. with geometrical screening 2.3, 3.4, 4.6, or 5.7 cm. at 10 cm. depth, angulated 10° to the feet, beginning at mid-pubis, with compression. S. Sacral field, 12 × 15 cm., with geometrical screening 2.3, 3.4, 4.6, or 5.7 cm. at 10 cm. depth, angulated 20° to the feet, beginning 2 cm. above the sacrococcygeal junction, with compression. G. Gluteal field, 10 × 4 cm., angulated 40° to the head, beginning 3 cm. off the mid-line and at the level of the sacrococcygeal junction, with compression.

The tissue dose is calculated for the obturator node (principal node). The column heading 3:3:3 indicates that each field receives the same dose. If one wants to irradiate somewhat more heavily the common iliac nodes, which receive practically no contribution from the radium system, the proportion 3:4:2 for A, S, and G, respectively, can be used.

iliac nodes. If rectal examination shows evidence of involvement of the uterosacral ligaments, the gluteal portals, which are closest to them, can be given a higher dose.

It is a sound practice to carry the side of the parametria and pelvic wall which is more involved to a higher dose. Toward the end of treatment, homolateral portals are used, the distance from the mid-line being determined by the irradiation already given.

Anterior Portals: The anterior portals are 12 to 14 cm. high and 15 cm. wide, with a central lead strip. The bony land-

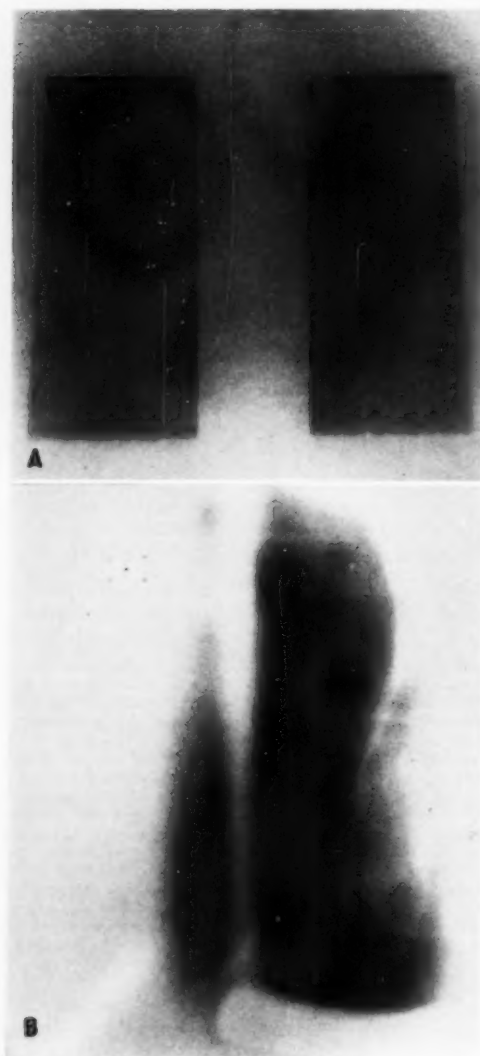


Fig. 6. A. Sacral field (14×5 cm.) divided in the center by a lead strip, 20° caudad. The entire bony pelvis, including the whole length of the sacroiliac joint and part of L-5, are included. The clips identifying the common iliac node group are seen.

B. Gluteal field with 40° tilt cephalad. The pelvic brim is seen elongated.

marks seen on the positioning check film are the same as for the whole pelvis technic and the tilt to the feet is 10° . The width of the mid-line screening has to be most accurately planned in relation to the volume distribution from the radium. It is also important that the screening be dis-

placed to the left or the right if the radium system is not centrally located.

Sacral Portals: The lower margin of the sacral portals is usually 2.5 cm. above the sacrococcygeal joint, and the tilt is 20° to the feet. Check films should show in its upper aspect the transverse process of L-5 (Fig. 6). The sacral portals contribute chiefly to the hypogastric and common iliac nodes, where the radium contributes little. Conversely, they contribute little to the pelvic wall areas to which the radium system contributes most. It is more anatomical, therefore, always to screen the mid-line, irrespective of asymmetry of the radium system, and to use a narrower central lead strip. It has been our practice to use 1.0 cm. less than for the anterior portals. A heavier dose can be delivered to the sacral portals than to the anterior ones to make up for the unhomogeneous contribution of the radium.

Gluteal Portals: The upper margin of the gluteal portals is on the average 2 cm. below the sacrococcygeal joint, and the tilt is 40° to the head. In addition, the patient's abdomen is propped on pillows, producing a partial knee-chest position. On the films, one should see the ischial tuberosity, the sciatic notch, and the posterior aspect of the pelvic brim (Fig. 6). The portals are always separate, one on each side, 3 cm. from the mid-line, 10 cm. high and 4 cm. wide. They are aimed at the distal end of the uterosacral ligaments and the lower sacral nodes. If the uterosacral ligaments are involved, a higher dose should be given to the gluteal portals, as there is relatively little contribution from either the anterior of the sacral portals, radium, or transvaginal therapy.

INFLUENCE OF SUPERVOLTAGE ON PELVIC IRRADIATION PLANNING

With the cobalt-60 unit, opposing portals can be used to deliver tumor doses up to 4,000 r for patients of up to 20 cm. anteroposterior diameter, without any appreciable skin reaction (Table II). It must, however, be kept in mind that the subcutaneous doses are 4,500 to 5,000 r, and

that late crippling fibrosis might develop. These high doses through two opposing portals should be reserved for very narrow parametrial portals. Whenever high doses are given to the whole pelvis, one anterior split portal and two posterior oblique portals provide the lowest subcutaneous dosage (4).

Because of the tremendously increased depth dose and the maximum ionization several centimeters below the skin, planning with the 22-MEV betatron is different. For the whole pelvis technic, anterior, posterior, and lateral portals are used. This gives an ideal volume distribution. The lateral portals are very effective, and their position can be varied in order to include, selectively, areas of involvement. For instance, a small lateral portal displaced slightly backward selectively irradiates the distal end of the uterosacral ligaments and the sacral nodes. For the treatment of the parametria in conjunction with radium therapy, opposing split portals can be used with effective screening of the mid-line.

If one plans to treat primarily by external radiation with doses of at least 6,000 r in six weeks with or without supplementary local therapy, portals 15 cm. high are used to cover part of the common iliac nodes. The same care must be exercised to determine the lower margin of the portals in order to irradiate the common iliac nodes as high up as possible. We have chosen to use such a plan for the late Stage II, Stage III, and Stage IV cases.

TABLES

Tables can be compiled for the various technic, *i.e.*, opposing split pelvic portals (Table II), anterior split portals and two posterior oblique portals (Table I), and parametrial portals (anterior, sacral and gluteal) (Table III), with or without weighted loading. The anteroposterior diameter, measured with compression, is taken as the parameter. The tables can be made to calculate tissue doses or to determine the respective skin doses necessary to deliver desired tumor doses.

Tables for the cobalt 60 (3 mm. Cu h.v.l.) beam demonstrate the gain of the 3-MEV level.

SUMMARY

The simplicity of securing anatomical accuracy of pelvic portals for external irradiation of cervical cancer is only apparent. It is essential, if one makes use of anatomical planning, designed to cover adequately but economically the tumor-bearing areas, to localize the cervix carefully and take films in treatment positions to make the necessary corrections for variations in positions and relationships.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

Ubicación de las Vías Pelvianas para la Irradiación Externa en el Carcinoma del Cuello Uterino

La disposición de las puertas pelvianas para la irradiación del carcinoma del cuello uterino no es cosa sencilla. Depende, primero, de la mira perseguida, ya sea el tratamiento del tumor primario y sus prolongaciones o el tratamiento de las caras laterales de los parametrios y los ganglios linfáticos solamente, como complemento de la irradiación local con radio intracavitario. Para el primer propósito, se comprende toda la pelvis; para el segundo, solamente una hoja de tejido que abarque las caras laterales de los parametrios y la pared de la pelvis.

Dos grupos de elementos anatómicos revisten importancia en el planeamiento de la terapéutica externa con haz: (1) la vagina, el cuello uterino, los tejidos parametriales, el cuerpo del útero y las caras medias de los ligamentos anchos y sacrouterinos; (2) las caras laterales de los ligamentos anchos y sacrouterinos y los ganglios de la pared pelviana. Los componentes del último grupo guardan una

relación fija y bastante constante con la pelvis ósea; en el primer grupo, esa relación varía considerablemente. Las diferencias individuales en la inclinación de la pelvis vedan el uso de los mismos puntos superficiales de referencia, aun los óseos, en todas las enfermas. Al determinar las vías pelvianas de entrada para tratamiento, resulta, por consiguiente, indispensable localizar con cuidado el cuello uterino y tomar radiografías en la posición de tratamiento para determinar los requisitos del caso dado.

Se ofrecen pormenores relativos a la disposición de las puertas pelvianas para la irradiación de toda la pelvis y para el tratamiento de los parametrios, ligamentos sacrouterinos y ganglios pelvianos, y se discute su aplicación a la terapéutica de supervoltaje. Se describe un calibrador de dos ramas que permite determinar la proyección del cuello uterino a las caras anterior y posterior del cuerpo para demarcar los campos de tratamiento.



A Simplified Method of Estimating Integral Dose in Radiotherapeutic Practice¹

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THE INFLUENCE of integral or volume dose upon the response of the patient was recognized empirically shortly after the first use of ionizing radiation for the treatment of human illness. Bécélère in 1915 noted that large-field irradiation is less well tolerated than that limited to small areas or volumes (1). Integral dose alone is certainly not sufficient to predict lethality, radiation illness, hematopoietic depression, or local reaction. The tissue irradiated, the size of the subject, and the protection of hematopoietic tissue are among the many variables shown to influence response (2-4). Recognizing these limitations, it is nevertheless likely that a useful correlation between integral dose and patient response for many treatment conditions may be obtained. For such clinical correlation to become routine, there must be a simple and reasonably accurate technic for calculating integral dose with each treatment planning.

Mayneord and his associates (5-7) initiated a formal and quantitative approach to the subject, proposing the "gram-roentgen" as a unit of measure and developing several mathematical solutions for the estimation of integral dose. Hap-
pey, Smithers, Ellis, and others have contributed to the development of this subject (8-11). These treatises are thorough, but they present computations too laborious for routine use. A simplified formula proposed by Mayneord (12) is given in the sections on integral dose in two frequently used texts on medical physics: those of Glasser, Quimby, Taylor, and Weatherwax (13), and of Johns (14). For this formula, $I = 1.44 \times A \times D_0 \times d_{1/2}$, to be perfectly accurate, the following conditions would be required: (a) exponential

decrease of dose; (b) parallel beam; (c) flat isodose surfaces; (d) complete absorption.

Since all of these conditions are only approximately realized, correction factors have been proposed to compensate partially for the deviations. The initial portion of the depth-dose curve is not exponential, because of forward scatter and, with multimillion-volt radiation, because of electron build-up. This portion can be estimated separately, and the formula used for the deeper, more exponential region. Mayneord, Quimby, and Johns add another term to the above formula to compensate for the divergence of the beam. Quimby also describes a method to correct for incomplete absorption due to the finite thickness of the patient. Thus, even the simplified formula leads to a series of calculations for each field used. The solution to be proposed here involves no new concepts. The intent rather is to simplify the calculations to the level of routine applicability, without unduly sacrificing accuracy.

The energy absorbed from a beam of radiation is equal to the energy of the radiation which enters the body, times the percentage of this which is absorbed within that body. The portion which is absorbed is dependent, in turn, upon the quality of the radiation, and the composition and size of the absorber. Most isodose charts of radiation distribution are obtained from measurements within phantoms of unit density material, and of sufficient cross section to permit only small loss of scattered radiation. If the body is very large in all dimensions, then practically all the radiant energy entering it will be absorbed within it. The intensity of primary radia-

¹ From the Department of Radiology, Temple University College of Medicine, Philadelphia, Penna. Presented at the Forty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 11-16, 1955.

tion is directly related to the air dose. Only part of the radiation which reaches the measuring device is absorbed and recorded, some or most of the energy passing through without interaction. To obtain total energy passing through an area, that is, energy flux, it is necessary to multi-

Mayneord (5) presented data on energy flux per roentgen for radiation from 20 to 2,000 kev, and in 1950 extended this to 100 MEV (15). Thus, to determine the integral dose in a phantom of infinite dimensions, it is necessary to know only the air dose, the field size, and the factor

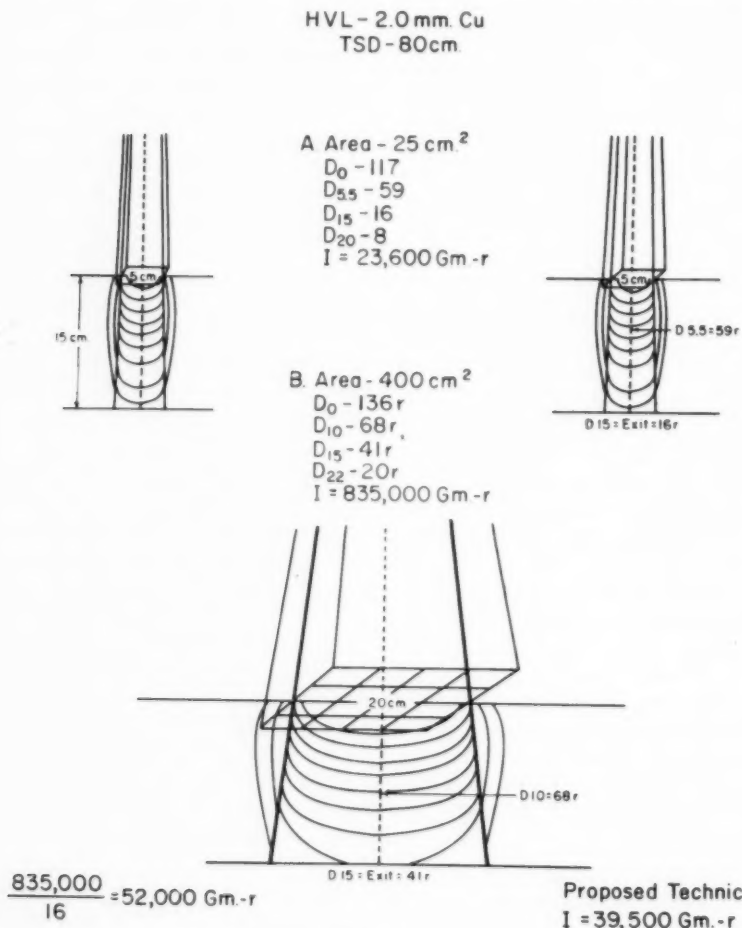


Figure 1

ply the measured quantity by a factor, energy flux per roentgen. This factor represents the ratio of radiation which passes through without interaction to that which is absorbed and measured. Naturally, the smaller the portion absorbed in a standard measuring device, the greater must be the conversion factor. In 1940,

for energy flux per roentgen for the quality of radiation used.

In absorbing bodies of less than infinite dimensions, this direct relationship no longer holds. Were it not for scattered radiation, the problem would still be relatively simple. The air and skin dose would be equal, the decrease in intensity

from a homogeneous parallel beam would be exponential and independent of field size, and the isodose surfaces would be flat. Scattered radiation results in a dependence of skin dose and of depth dose, and of the ratio between them, upon field size when the air dose is kept constant.

Figure 1 illustrates the errors in the estimation of integral dose which these deviations from the ideal may cause. Two widely separated 5×5 -cm. fields are shown, of h.v.l. 2 mm. Cu at a target-skin distance of 80 cm. Each receives 100 r as measured in air, giving a mid-line skin dose of 117 r, with half of this dose at 5.5 cm. The integral dose from the surface to 15 cm. for each field is calculated from the exponential formula, corrected for beam divergence and exit dose, to be 23,600 gram-roentgens. It is obvious that the integral dose from these two fields is exactly twice that from either one alone. Now, as an extreme example, if sixteen 5×5 -cm. fields are placed together to give one 20×20 -cm. field to which an air dose of 100 r is administered, the mid-line skin dose becomes 136 r, half this dose occurs at 10 cm. depth, and the integral dose to 15 cm. is calculated to be 835,000 gram-roentgens. One-sixteenth of this, or the contribution from each 5×5 -cm. area, is 52,200 gram-roentgens. The calculations are shown in Figure 2. Thus, for 100 r in air to each 5×5 -cm. field, there is an apparent change from 24,000 to 52,000 gram-roentgens, an increase of over 100 per cent. This apparent increase with increasing field size is to be expected. The equation does not directly consider radiation which has been scattered beyond the geometrical confines of the beam. Proportionally, there is more radiation lost by scatter from a small beam than from a large one, so that the calculated integral dose will be correspondingly low for the small beam.

An alternative method for determining the absorption of both primary and scattered radiation from any field will now be presented. Consider a phantom of infinite size being irradiated by a uniform

$$I = 1.44 \times D_0 \times A \times d_{1/2} \times \left[1 + 2.88 \left(\frac{d_{1/2}}{f} \right) + 4.16 \left(\frac{d_{1/2}}{f} \right)^2 \right]$$

5 x 5 cm, 2.0 mm Cu HVL, 80 cm TSD, 100 r air

$D_0 = 117 r$	$D_{exit} = 16 r$
$A = 25 \text{ cm}^2$	$A = 35 \text{ cm}^2$
$d_{1/2} = 5.5 \text{ cm}$	$d_{1/2} = 5.0 \text{ cm}$
$f = 80 \text{ cm}$	$f = 95 \text{ cm}$

$$I_{infinite} = 1.44 \times 117 \times 25 \times 5.5 \times \left[1 + 2.88 \left(\frac{5.5}{80} \right) + 4.16 \left(\frac{5.5}{80} \right)^2 \right]$$

$$= 28,300 \text{ gm-r}$$

$$I_{exit} = 1.44 \times 16 \times 35 \times 5.0 \times \left[1 + 2.88 \left(\frac{5.0}{95} \right) + 4.16 \left(\frac{5.0}{95} \right)^2 \right]$$

$$= 4,700 \text{ gm-r}$$

$$I_{0-15} = 23,600 \text{ gm-r}$$

Figure 2

parallel beam of infinite cross section. Each line through the phantom parallel to the beam would then have the same depth-dose distribution as every other parallel line, since each must receive the same contribution of primary radiation and the same scattered radiation from any distance in any direction. The isodose surfaces would be perfectly flat. Further, the depth-dose values would be the same as those which would be obtained within a very small field if all of the scattered radiation remained and were absorbed within the geometrical confines of the beam. A scattered ray is as likely to originate in one line and be absorbed in another, as to originate in the second and be absorbed in the first. This is true for every line about the line of interest, an equilibrium having been established with identical secondary radiation leaving the line of interest and entering it. From depth-dose data obtained under these conditions, a curve of integral dose per roentgen in air per square centimeter of field size could be constructed by mechanical integration for each quality of radiation. Under the conditions of a parallel beam being absorbed in an infinite phantom, a true integral dose could then be obtained to any depth for any field size, if the air dose, field size, and radiation quality were known.

Since the infinite dimensions required for theoretical perfection are unattainable, the

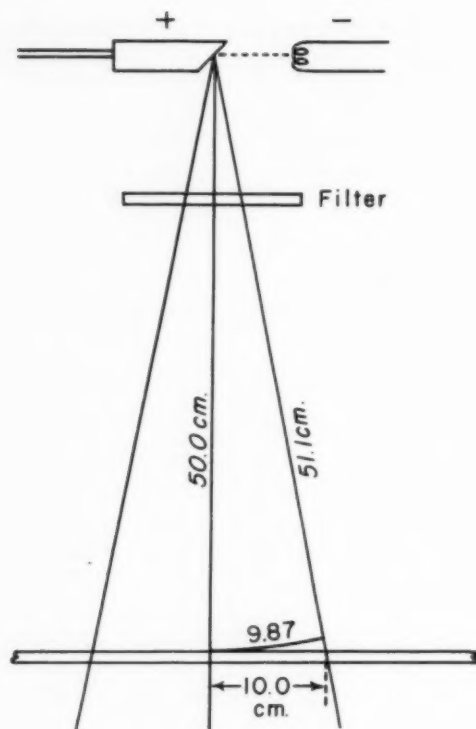


Figure 3

effects of phantom size, field size, and focal-skin distance must be analyzed to establish the usefulness of data obtained under more plebeian conditions. Two considerations limit the required size of the phantom used to obtain the initial depth-dose curves. First, it need only be of such size that the radiation scattered from the edges to the central portion be measurable. The cross section of the beam likewise need be no greater than this maximal size. The actual dimension required is dependent upon the quality of the radiation but reasonable accuracy will be obtained with a phantom of 30 to 40 cm. square. Two techniques employed to assure that the field and phantom sizes used for these studies were adequate, were:

1. Decreasing the field size by several centimeters. Measurable decrease in depth dose to a mid-line point would indicate inadequate field size.
2. Leaving the geometrical arrange-

ment unchanged and taking readings at a given depth several centimeters away from the mid-line. Measurable deviation from the mid-line reading would indicate curved isodose surfaces in the mid-portion of the beam and, therefore, lack of scatter equilibrium.

The second consideration limiting the required size of the phantom is that it need be no larger than a person. A small beam directed through the center of a patient will produce some, though perhaps negligible, scattered radiation which will escape from the body laterally. This lost radiation will be identical in quantity and quality to that which would reach the center of an infinite phantom in a beam of infinite cross section, scattered from the region of the phantom beyond the dimensions of the patient. Thus, the depth-dose curve for integral dose estimation may quite practically be obtained by irradiating a phantom of 30 to 40 cm. square in a beam of the same cross section.

The divergence of the beam must be considered from the point of view of obtaining the initial integral dose curve, as well as from that of the subsequent use of this curve in therapy at limited target-skin distance. To obtain the curve, using a target-surface distance of 400 cm., would result in a reading at a depth of 20 cm. which would be about 10 per cent lower than that obtained from a parallel beam. Correction of the data on the basis of the inverse-square law, while perhaps not strictly correct, will reduce this error. Since it will then be limited to a few per cent of an already low depth dose, the maximum error will be of no significance.

The depth-dose data having been obtained in this manner, the curve of integral dose with thickness of part can now be constructed. In essence, this consists of adding the average doses within each centimeter layer down to each depth. For example, for 100 r in air of radiation of h.v.l. 3.0 mm. Cu, the first centimeter averages 139 r, the next 145, and the third 144. Then to 3 cm. depth, there will be

428 gram-r per square centimeter per 100 r in air, or a factor of 4.28 per roentgen. This factor is obtained for each depth, and a curve is drawn from these values. In practice, a mechanical integrator is used with the plotted depth dose curve, for greater precision.

In the use of the curves, several errors,

The maximum increase in travel will be about 2 per cent over the mid-line ray. The decrease in intensity resulting from this will not exceed 1 or 2 per cent. At the same time, the radiation at the edge of the beam must travel about 2 per cent further through the body, increasing the absorbed dose to a similar small degree.

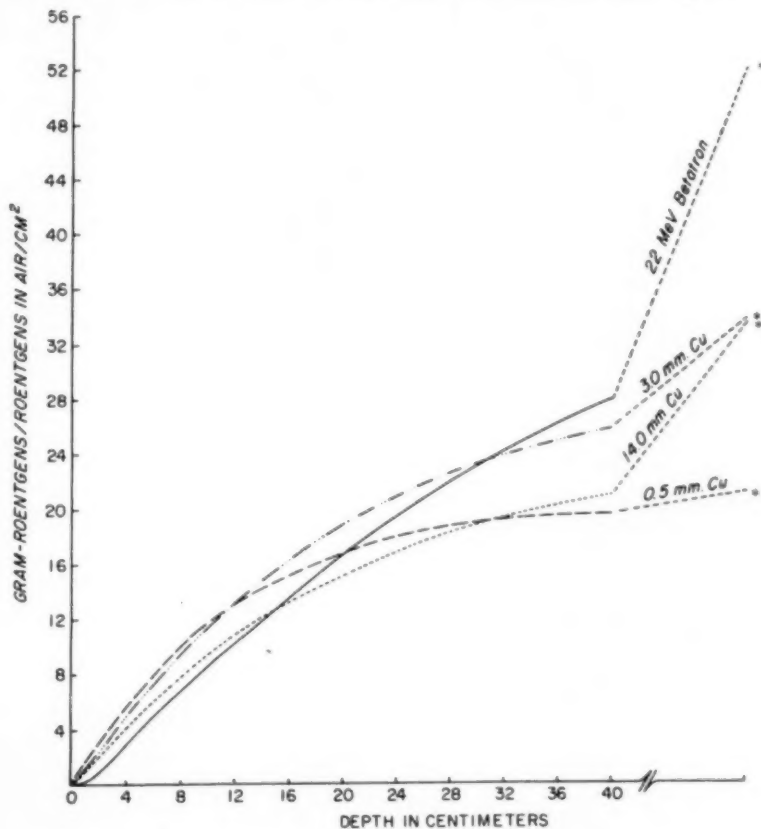


Figure 4

most pronounced with large fields and short skin distances are evident. These errors are shown diagrammatically in Figure 3. First, a field which measures 20×20 cm. on a plane surface 50 cm. from the target represents only a 19.7×19.7 field on the surface of a sphere of 50 cm. radius, a difference in surface area of about 3 per cent. At the edge of the beam, there will also be some additional loss of intensity due to oblique passage through the filter.

Depth dose data were collected in our department for radiation of h.v.l. 0.5, 3.0, and 14.0 mm. Cu. These were obtained for the less penetrating radiation with a Westinghouse 250 KVCP machine operated at voltages of 150 and 250 kv. The measurements were taken in a Presdwood phantom 30 cm. square, at a target-surface distance of 4 meters, and corrected to infinite distance by inverse-square factors. The data for the higher quality

radiation were obtained with a 2-MEV Van de Graaff generator. A 45-cm. square phantom was used for measurements, with a target-to-surface distance of 10 meters. No inverse-square corrections were made. The curves for 22-MEV radiation were drawn from data published

from this plan for simplicity. Six cross-firing 6×15 -cm. fields are used to deliver a mid-point tumor dose of 4,000 r/4 weeks, with 250-kvp radiation, h.v.l. 3.0 mm. Cu, at a target-skin distance of 50 cm. This requires a total air dose to each field of 3,400 r. The direct anterior

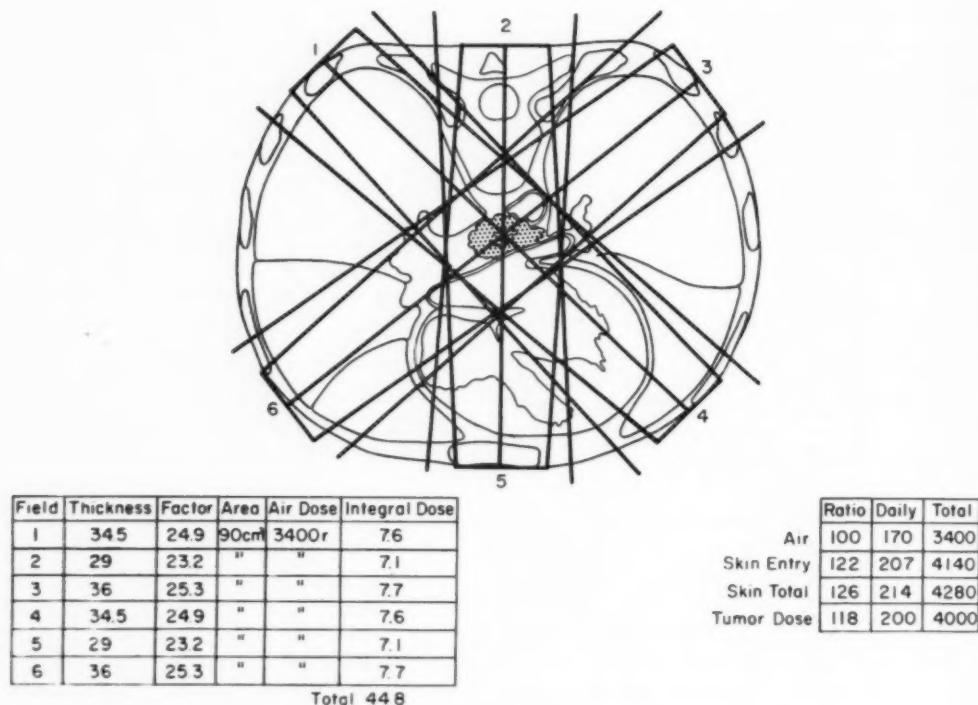


Figure 5

by Laughlin (16). A copper compensating filter had been used by Laughlin to obtain flat isodose surfaces. Figure 4 shows the curves for radiation of 0.5, 3.0, and 14.0 mm. Cu h.v.l. and for the 22-MEV betatron. The asterisk at the end of each curve indicates the energy absorption to infinite thickness computed from Mayneord's data on energy flux per roentgen for each quality of radiation.

An example is given to illustrate the use of the curves in practice. Figure 5 shows a treatment plan for the irradiation of a carcinoma of the esophagus. The customary isodose pattern has been elim-

inated from this plan for simplicity. Six cross-firing 6×15 -cm. fields are used to deliver a mid-point tumor dose of 4,000 r/4 weeks, with 250-kvp radiation, h.v.l. 3.0 mm. Cu, at a target-skin distance of 50 cm. This requires a total air dose to each field of 3,400 r. The direct anterior

and posterior beams each pass through 29 cm. of tissue. The thickness factor from the curve for h.v.l. 3.0 mm. Cu for 29 cm. is 23.2 gm.-r/r in air/cm.² The integral dose from each of these two fields is then:

$(6 \times 15) \text{ cm.}^2 \times 3,400 \text{ r (air)} \times 23.2 \text{ gm.-r/r (air)/cm.}^2 = 7,099,200 \text{ gm.-r or 7.1 mgr.}$

Two of the oblique fields each pass through 34.5 cm. of tissue, the thickness factor being 24.9 gm.-r/r in air/cm.² The integral dose from each of these fields is then:

$(6 \times 15) \text{ cm.}^2 \times 3,400 \text{ r (air)} \times 24.9 \text{ gm.-r/r (air)/cm.}^2 = 7,619,400 \text{ gm.-r or 7.6 mgr.}$

The other two oblique fields are 36 cm. thick, the factor for these fields being 25.3 gm.-r/r in air/cm.² The integral dose per field is:

$$(6 \times 15) \text{ cm.}^2 \times 3,400 \text{ r (air)} \times 25.3 \text{ gm.-r/r (air)/cm.}^2 = 7,741,800 \text{ gm.-r} = 7.7 \text{ mgr.}$$

The total integral dose for this course of treatment is then:

$$2 \times 7.1 \text{ plus } 2 \times 7.6 \text{ plus } 2 \times 7.7 = 44.8 \text{ mgr.}$$

In conclusion, a series of curves has been presented, one for each of several qualities of radiation, showing the dependence of integral dose upon thickness of the absorbing body. By multiplying the air dose delivered to a field by the area of that field, and by the thickness factor obtained from the appropriate curve, an integral dose may be computed which will be reasonably correct if the absorbing material is of unit density. For heterogeneous media, the errors will be similar to those resulting from the use of standard isodose curves under the same circumstances. It is the intent of this presentation to offer a technic for estimating integral dose which is sufficiently simple that it may be used as a routine for every treatment plan. It is hoped that better correlation of dose and effect may thus be attained.

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SUMARIO

Método Simplicado para Computar la Dosis Integra en la Práctica Radioterapéutica

Tiene por fin esta exposición ofrecer una técnica para calcular la dosis total, que sea suficientemente sencilla para poder usarla sistemáticamente en todo plan terapéutico. Preséntase una serie de curvas, una para cada una de varias clases de irradiación, mostrando la supeditación de la dosis íntegra al espesor del cuerpo absorbente. Multiplicando la dosis al

aire entregada a un campo por el área de dicho cuerpo, y por el factor de espesor obtenido por la curva apropiada, cabe computar una dosis íntegra que será razonablemente exacta si la substancia absorbente posee densidad uniforme. Para medios heterogéneos, el error será semejante a los derivados del uso de curvas normalizadas de isodosis en las mismas circunstancias.

The Results of Re-Irradiation in Cancer of the Cervix¹

WALTER T. MURPHY, M.D., and ALFRED SCHMITZ, M.D.

AT A TIME WHEN surgical intervention is loudly proposed for recurrent cancer of the cervix, it is well to analyze the indications, end-results, and complications of renewed radiotherapy in failures following an apparently adequate course of radiation. Little has been written on this problem since the advent of modern fractionated x-ray and protracted radium technics. It is commonly thought, and taught, that if an initial intensive course of radiation fails, further irradiation is contraindicated. This premise is often borne out by disastrous results following injudicious repetition of treatment courses. Sometimes, however, it is quite rational and feasible to apply a radiation source to a cancer site even though classically intensive irradiation has already been administered. This is particularly justified in those cases where an alternative surgical attack for curative purposes would entail not only an appreciable mortality risk but also a high degree of permanent disability.

It has been the experience at the Roswell Park Memorial Institute that a fair percentage of patients with cervical cancer have survived five years or more following retreatment for recurrences or for persistent disease. Since, in the early years, the initial treatment was in many instances with x-ray doses that today seem inadequate (although intense radium doses were also given), it is not strange that in some cases supplemental radiation proved beneficial. Dr. James Palmer, head of this Institute's Gynecology Department, in an unpublished study of 1,167 patients with cervical cancer treated during the years 1936 to 1941, found that 461 (39.6 per cent) had been re-irradiated. In these instances, the original treatment was either by a massive x-ray and radium

technic within six days or by a more prolonged technic (though not as fractionated as in the present study). In the former group, the average total doses (x-ray and radium) were 6,400 r at Point A and 1,450 r at Point B; in the latter group comparable doses were 8,700 r at Point A and 4,000 r at Point B.²

Of the cases treated by the massive technic, 46.8 per cent required retreatment, while of the fractionated group, 25.2 per cent were retreated. The primary five-year cure rate for the 1,167 cases was 33.3 per cent. Of the 461 retreated patients, 20 per cent lived five or more years after retreatment without clinical evidence of cancer. In the majority of the cases, re-irradiation was by combined x-ray and radium.

In more recent years, the initial x-ray and radium regime has been quite consistently intense. The fact that recurrences or persistent cancer have been seen means that in some instances the technic (dose-time relationship, tumor coverage, etc.) was not optimal. For information concerning cases of this type, a review was made of patients retreated for recurrence between Jan. 1, 1946, and Aug. 1, 1950.

Table I shows the end-results for all patients with cervical cancer treated from 1946 through 1949. Since the best general results were obtained in patients receiving x-ray therapy through multiple converging pelvic ports, supplemented by radium either immediately before or after the completion of external therapy, only such cases were included in this study, and these were not considered to have had "adequate" treatment unless anatomical Points A and B received, respectively, total doses of 7,000 and 4,500 r (from x-ray and radium). In most cases, the dosage

¹ From the Department of Radiation Therapy, Roswell Park Memorial Institute, Buffalo, N. Y. Presented at the Forty-first Annual Meeting of The Radiological Society of North America, Chicago, Ill., Dec. 11-16, 1955.

² Point A and Point B are 2 and 5 cm., respectively, lateral to the center of a tandem intrauterine applicator.

TABLE I: RADIATION END-RESULTS IN CANCER OF THE CERVIX, ROSWELL PARK MEMORIAL INSTITUTE

Year	Stage I			Stage II			Stage III			Stage IV			TOTAL		
	No. Cases	No. NED	Per Cent NED	No. Cases	No. NED	Per Cent NED	No. Cases	No. NED	Per Cent NED	No. Cases	No. NED	Per Cent NED	No. Cases	No. NED	Per Cent NED
1946	49	33	67.3	62	27	43.5	64	23	35.9	20	1	5.0	195	84	43.1
1947	25	18	72.0	61	32	52.5	64	27	42.2	19	2	10.5	169	79	46.7
1948	42	37	88.0	52	29	55.8	40	12	30.0	7	2	28.5	141	80	56.7
1949	59	40	67.8	41	24	58.5	42	14	33.3	14	1	7.1	156	79	50.6

NED—No evidence of disease.

TABLE II: PATIENTS ALIVE AND WITHOUT CANCER AFTER RETREATMENT

Original Clinical Stage (International)	Number Cases	Interval before Retreatment Months		Type of Therapy			Classification at Retreatment*			Length of Life (in years) after Retreatment	
		Average	Ex-tremes	X-ray	Radium	Com-bination	A	B	C	Average	Ex-tremes
I	2	7	5-9	1	...	1	2(2)	...	...	6.5	6-7
II	3	10	7-15	1	2	...	3(2)	...	...	7.2	7-7.5
III	4	13	6-23	1	2	1	4(3)	...	...	7.5	7-8
IV	0	...	...	...	...	...	...	...	...	...	...
TOTAL	9	10.6	5-23	3	4	2	9(7)	...	...	7.2	6-8

* The figure in parenthesis represents the number of cases with positive biopsy.

TABLE III: PATIENTS DEAD AFTER RETREATMENT

Original Clinical Stage (International)	Number Cases	Interval before Retreatment Months		Type of Therapy			Classification at Retreatment*			Length of Life (in months) after Retreatment†	
		Average	Ex-treme	X-ray	Radium	Com-bination	A	B	C	Average	Ex-treme
I	3	41	13-89	2	1	...	2(2)	...	1(1)	19	6-41
II	19	18	6-78	12	6	1	12(10)	5(3)	2(1)	12	2-26
III	14	12	4-38	10	2	2	9(5)	2	3(3)	14	2-32
IV	1	7	7	1	...	...	...	...	1	6	6
TOTAL	37	17	4-89	25	9	3	23(17)	7(3)	7(5)	13	2-41

* The figure in parentheses represents the number of cases with positive biopsy.

† Length of life after original irradiation: *average, thirty months; extremes, eleven and ninety-nine months.

was above this level. As a result of this basic selection, the study comprises 46 cases of squamous-cell carcinoma. Tables II and III show the original staging of these cases.

The minimum and average doses originally administered, with time intervals, are shown in Table IV. The average interval between the first course of treatment and the second was 13.7 months, with a range from four to eighty-nine months (Tables II and III). No apparent correlation between the time interval and the subsequent result was evident. The average age at retreatment in the surviving group was forty-one years, the youngest patient being thirty-one and the

oldest fifty-one years. For the non-survivors, the average was forty-eight years, with a range of thirty-one to seventy.

INDICATIONS FOR RETREATMENT

To determine whether or not there were any favorable indications for retreatment, the 46 cases were classified as follows:

A. Recurrence present in one or more of the following sites: cervix, vagina, rectum, bladder, broad ligament (not massive frozen pelvis).

B. A massive fixed pelvic mass or identifiable pelvic neoplasm with the patient in obviously poor physical condition, as manifested by edematous lower extremity, uremia, etc.

TABLE IV: ORIGINAL TOTAL ROENTGEN DOSES (FROM X-RAY AND RADIUM) AND TIME PERIODS

	Minimum Total Dose			Average Total Dose		Average Days	Extreme Days
	No. Cases	Point A	Point B	Point A	Point B		
Alive (5 yr. +)	9	8,500	5,200	8,600	5,700	46	29-82
Dead	37	7,700	4,500	8,700	5,700	48	29-66

C. Spread of the cancer beyond the pelvis.

Tables II and III list the number of patients in these different classes. It will be noted that all surviving patients belonged to Class A.

This study emphasizes that the most favorable indication for retreatment in cervical cancer is a lesion limited to the true pelvis in a patient in otherwise good physical condition. Massive fixation of the pelvic structures does not invite a good result. Of the 9 patients in the series who are living, 3 at the time of retreatment had involvement of the cervix only; 1 had an indurated vaginorectal septum with induration in both broad ligament areas; 1 had cervical involvement with left parametrial extension; 1 had an ulcerated cervix with extension into the right fornix; in 1 there was involvement of the vaginorectal septum; 1 had a recurrent nodule in the right fornix; 1 had cancer in a vesicovaginal fistula.

Every clinical diagnosis of recurrent or persistent cancer should be verified by biopsy if at all feasible. In our series, positive biopsies were obtained in 7 of the 9 surviving patients and in 25 of the 37 who died. In the cases without biopsy confirmation, two or more senior staff examiners had concluded that cancer was present. Tissue changes resulting from the original irradiation do not contraindicate further radiotherapy if the examiner feels that cure or palliation is possible; in such a decision, however, the possibility of complications or sequelae from re-irradiation must be considered.

TECHNIC OF RETREATMENT

Tables II and III show that, of the 9 surviving patients, 4 were treated by local radium applications only, 3 were given

external x-ray therapy only, and 2 received a combination of external x-ray therapy and local radium application. Of the 37 patients who died, 25 received x-ray treatment only, 9 local radium only, and 3 a combination of the two. This serves to emphasize that in most of the unsalvaged patients, disease was so extensive that externally applied roentgen radiation was the only feasible method of treatment. In 38 per cent of the patients in this group, the cancer extended beyond the pelvis, the physical condition was very poor (e.g., uremia), or there was massive pelvic involvement.

The actual radiation technics depended upon the clinical picture. In order to demonstrate as briefly as possible what was done, 4 case reports are hereby recorded. All roentgen doses were tissue doses. X-ray treatments were given Monday through Friday.

CASE I: Radium Only for Retreatment. M. K., 33 years of age, was admitted to the hospital on Sept. 29, 1947, with a history of intermenstrual bleeding for two months. The cervix was grossly enlarged, with multiple lacerations. There was an ulcerated induration about the external os, extending into the posterior fornix and medial left broad ligament. Biopsy showed squamous-cell carcinoma, clinical Stage II.

Roentgen therapy was given from Sept. 29 to Nov. 3, at 400 kvp (h.v.l. 5.0 mm. Cu) through converging anterior right and left ports (10 × 15 cm. at 40° angulation with 7 cm. separation) and converging posterior right and left ports (8 × 15 cm. at 30° angulation with 11 cm. separation). The focus-skin distance was 70 cm. The four ports received a surface increment of 150 r daily for twenty-five cycles, for a total surface dose of 3,750 r to the anterior ports and 3,970 r to the posterior ports. The total depth dose was: 4,850 r to the center; 4,850 r to Point A; 5,100 r to Point B.

Radium treatment was instituted on Nov. 12, nine days after completion of x-ray therapy. An intrauterine-cervical applicator was used, consisting of three 10-mg. cells in tandem and two 10-mg. cells across the face of the cervix (filter 1.0 mm. platinum

and 1.0 mm. steel). In sixty-four hours, a dose of 3,760 r was delivered to Point A and 800 r to Point B.

On April 2, 1948 (four-and-one-half months after irradiation), there was a small area at the external os which bled easily. Biopsy showed this to be squamous-cell carcinoma. There were no other abnormal findings.

Retreatment: On May 10 (six months after irradiation) a vaginal radium applicator was applied against the cervix for forty-eight hours. This consisted of a 50-mg. tube (filter 1.0 mm. platinum) in a bakelite jacket of 8.0 mm. wall thickness. The calculated dose to a point 2 cm. from the center of the source was 4,320 r, and at 5 cm. 700 r.

On Sept. 20 (four months after retreatment), superficial vaginal adhesions were present, as well as induration of the upper vaginorectal septum. Biopsy of the cervix disclosed scar and necrotic tissue.

On June 8, 1955 (almost seven years after retreatment), there was atresia of the upper end of the vagina with moderate fibrosis in the parametrial areas. The patient had no complaints.

Comment: This case illustrates what may be accomplished by local radium therapy for an apparently limited recurrence in spite of the fact that a large total dose of radiation had been applied a few months earlier.

CASE II: X-Ray Only for Retreatment. I. L., 30 years of age, was admitted on Jan. 24, 1949, with a history of vague discomfort in the lower abdomen of four months duration. Routine pelvic examination revealed a cervical lesion. The cervix was firm and grossly enlarged. Biopsy showed a squamous-cell carcinoma, clinical Stage I.

Röntgen therapy was given from Jan. 25 to March 8 at 400 kvp (h.v.l. 5.0 mm. Cu) through converging anterior right and left ports (10 × 15 cm. at 35° angulation with 13.5 cm. separation) and converging posterior right and left ports (10 × 15 cm. at 38° angulation with 11 cm. separation). The focus-skin distance was 70 cm.

The surface increment to the four ports was 150 r daily for thirty cycles, for a total surface dose of 4,450 r to the anterior ports and 4,410 r to the posterior ports. The total depth dose was: 4,630 r to the center; 4,630 r to Point A; 4,720 r to Point B.

Radium treatment was begun on March 9, the day after the completion of x-ray therapy. An intrauterine-cervical applicator was used, with three 15-mg. cells in tandem and two 15-mg. cells across the face of the cervix (filter 1.0 mm. platinum and 1.0 mm. steel). In fifty-four hours a dose of 4,100 r was delivered to Point A, and 1,020 r to Point B.

On June 2 (three months after radium treatment), a cervical reaction was noted, and a smear showed tumor cells. A biopsy of the posterior lip, on Aug. 25, disclosed "granulation tissue with areas

suspicious of malignancy." Cervical biopsy one month later showed scar tissue. On Nov. 21 (eight months after irradiation) the cervix appeared to be healed, but there was a fixed hard mass in the right broad ligament area, which was considered to be cancer.

Retreatment: X-ray therapy was given from Nov. 28 to Dec. 21 at 400 kvp (h.v.l. 5.0 mm. Cu) through anterior and posterior opposing right mid-pelvic ports (15 × 15 cm.) and a lateral right pelvic port (10 × 15 cm.). The surface increment to the three ports was 200 r daily for seventeen cycles. The total surface dose was 4,010 r to the anterior and posterior ports, and 3,400 r to the lateral port. The total tumor dose was 4,110 to 5,130 r.

At an examination on April 12, 1950, four months after treatment, there was slight induration in the right parametrial area, but twelve months later this had disappeared.

On March 14, 1955, the patient "felt fine." The skin was in good condition. There was minimal fibrosis in the pelvic floor but no clinical evidence of cancer, and no tumor cells were revealed on cytologic study.

Comment: Within a nine-month period this patient was given two courses of x-ray therapy, 4,600 r and 5,100 r, respectively, to an area that had received also an original radium dose of 3,800 r. Although there was some overlapping of the x-ray fields, the skin, over five years later, is in good condition. The patient has no untoward functional complaints. The parametrial pathology was not identified histologically, but it was the conclusion of two experienced examiners that it should be considered malignant.

CASE III: X-Ray and Radium for Recurrence. M. S., 42 years of age, was admitted on Jan. 30, 1948, because of a bloody discharge of four months duration. The cervix was thickened and showed an erosion on the anterior lip with indurated extension into the right fornix. Biopsy revealed squamous-cell carcinoma, clinical Stage II.

X-Ray therapy was given from Jan. 30 to March 24 at 400 kvp (h.v.l. 5.0 mm. Cu) through converging anterior right and left ports (8 × 15 cm. at 35° angulation with 6 cm. separation) and converging posterior right and left ports (8 × 15 cm. at 35° angulation with 7.5 cm. separation). The focus-skin distance was 70 cm. All ports received 150 r daily for five cycles and 100 r daily for thirty-one cycles. The total surface dose was 3,850 r to the anterior ports and 4,045 r to the posterior ports. The total depth dose was: 4,700 r to the center; 4,700 r to Point A; 4,770 r to Point B.

Radium treatment was instituted on March 24, with an intrauterine-cervical applicator with three

10-mg. cells in tandem and two 15-mg. cells across the face of the cervix (filter 1.0 mm. platinum and 1.0 mm. steel). In fifty-five hours, a dose of 3,740 r was delivered to Point A, and 820 r to Point B.

On Sept. 10 (about six months after irradiation), an induration on the right side of the cervix, extending into the fornix, was observed. Biopsy showed squamous-cell carcinoma.

Retreatment: The second course of x-ray therapy, begun almost seven months after the first, was given from Oct. 11 to Dec. 8, at 400 kvp (h.v.l. 5.0 mm. Cu) through converging anterior right and left ports (8×15 cm. at 35° angulation with 8.5 cm. separation) and converging posterior right and left ports (8×15 cm. at 35° angulation with 10.5 cm. separation). The focus-skin distance was 70 cm. All ports received 150 r daily for three cycles, and 100 r daily for thirty-seven cycles. The total surface dose was 4,150 r to the anterior ports and 4,350 r to the posterior ports. The total depth dose was: 5,000 r to the center; 5,010 r to Point A; 5,230 r to Point B.

Radium therapy was instituted on Dec. 8, 1948 (the last day of x-ray treatment), a vaginal applicator being placed against the cervix for forty-eight hours. It consisted of one 50-mg. cell (filter 1.0 mm. platinum) in a bakelite container of 8.0 mm. wall thickness. The dose at a point 2 cm. from the center of the source was 4,320 r, at 5 cm. 700 r.

On July 25, 1949 (seven months after radium treatment), the patient reported severe pain on defecation with attendant rectal bleeding of three weeks duration. Examination revealed an ulceration just above the pectinate line on the anterior rectal wall, surrounded by induration. The posterior vaginal wall was thickened and fixed. There was no gross evidence of cancer. Conservative treatment was prescribed.

On April 5, 1955 (more than six years after re-treatment) the patient complained of intermittent bloody stools. Examination showed the vaginal mucosa to be pale and atrophic, with some telangiectasis. The vault was obliterated and the anterior rectal wall was granular. There was no evidence of cancer.

Comment: Within an interval of seven months, two intensive courses of radiation (x-ray plus radium) were given in this case. Although the patient experiences intermittent discomfort from proctitis, pelvic functions are almost normal.

CASE IV: Retreatment by Radium of a Carcinomatous Vesicovaginal Fistula. M. D., 37 years of age, was admitted on April 14, 1947, with a history of intermenstrual spotting of six months duration. A large slough was observed on the cervix, in an area which the patient's personal physician had cauterized. The cervix was almost flush with the vault. There was a large indurated mass in the

right fornix with fixed induration of both broad ligaments. Biopsy showed squamous-cell carcinoma, clinical Stage III.

X-ray therapy was given from April 14 to May 21 at 400 kvp (h.v.l. 5.0 mm. Cu) through converging anterior right and left ports (10×15 cm. at 40° angulation with 7 cm. separation) and converging posterior right and left ports (10×15 cm. at 35° angulation with 11.5 cm. separation). The focus-skin distance was 70 cm. The surface increment was 600 r to one port per day for seven cycles. The total surface dose was 4,160 r to the anterior ports and 4,410 to the posterior ports. The total depth dose was: 4,700 r to the center; 4,700 r to Point A; 4,790 r to Point B.

Radium treatment was instituted on May 21, the last day of x-ray treatment. An intrauterine-cervical applicator was used, with three 10-mg. cells in tandem and two 10-mg. cells across the face of the cervix (filter 1.0 mm. platinum and 1.0 mm. steel). In seventy hours, a dose of 4,120 r was given to Point A and 876 r to Point B.

On August 15 (three months after irradiation), there was some scarring of the cervix and right fornix but no appreciable induration in the broad ligament areas.

On Nov. 7 (about six months after irradiation), the patient reported slight vaginal bleeding the previous day. Examination revealed an ulcer on the cervix with induration in the left paracervical area. Biopsy showed "erosion." Findings on cystoscopy were normal.

On Aug. 18, 1948 (fifteen months after radiation), the patient stated that she had experienced urinary incontinence during the previous week. Examination showed a vesicovaginal fistula. Biopsy of the edges of this tract revealed squamous-cell carcinoma. There was no other evidence of cancer.

Retreatment: On Aug. 23, two tandem 15-mg. radium tubes (filter 1.0 mm. platinum and 1.0 mm. steel) in a French catheter (No. 18) were placed in the fistulous tract after dilatation for seventy-two hours. The dose was 10,150 r at a point 1 cm. from the center of the tandem, 2,980 r at 2 cm., and 540 r at 5 cm.

On Sept. 2, a bilateral ureterosigmoidostomy was performed, followed by a cystectomy, panhysterectomy, and partial vaginectomy three weeks later. Histologic examination of the operative specimen revealed no evidence of cancer.

On July 13, 1950, the patient stated that for ten days stool and urine had been passed through the vagina. A rectovaginal fistula was found in the vault of the vaginal tract.

On Sept. 21, 1954 (six years after re-treatment), the general condition was excellent although slight leaking through the rectovaginal fistula persisted. There was no evidence of cancer.

Comment: This case was the only one in which postirradiation surgery was per-

formed. The vesicovaginal fistula was a result of cancer which was eradicated by a second course of irradiation. The surgery was done for obvious non-neoplastic reasons and, though it did not play a part in the eventual cure of this patient, it did contribute to her comfort. The rectovaginal fistula could be ascribed to the heavy irradiation plus the tissue alterations caused by the surgical procedure. The large x-ray increment dose technic (600 r to one port daily) used initially has been discontinued because of the induced normal tissue morbidity.

COMPLICATIONS

The following is a list of the complications following retreatment in the 9 patients free of cancer at the present writing. All were socially active and relatively comfortable.

1. Chronic proctitis, 1 case (Stage II).
2. Chronic cystitis, 1 case (Stage II).
3. Chronic proctitis and cystitis, 1 case (Stage III).
4. Rectovaginal fistula, 1 case (Stage III).

In a fifth case, already described, a vesicovaginal fistula developed after the first irradiation course and a rectovaginal fistula two years following re-irradiation and extended surgery. A sixth patient had a slough in the right buttock as a result of too intensive x-ray treatment (500 r to one port per day) initially, but this had no bearing upon the retreatment problem. Excision of this skin area was followed by complete healing. The recurrence in this case was confined to the cervix and was successfully controlled by endocervical radium.

All the radium applicators were well fixed and packed. Due to tissue fixation resulting from previous irradiation, it is sometimes difficult, even under anesthesia, to pack a radium source as far away from the bladder and rectum as in a non-irradiated patient. When the disease is contiguous to the rectum or bladder, these structures must be in the treatment field. It is not easy to place lower or upper limits

upon the dosages used in retreatment. If cure is the goal, dosages that the radiotherapist has found to be cancerocidal must be employed. It is possible that better follow-up care, both medical and nursing, might decrease the morbidity. In the problem of recurrent or persistent cancer, however, a certain amount of courage is necessary to attempt a cure.

Adequate surgical methods for a comparable goal certainly carry a fairly high incidence of complications and sequelae. Brunschwig (1), nevertheless, in a recent personal communication writes: "When a patient has cancer that has failed to respond to radiation or has recurrence after radiation, our experiences are such that we can categorically say that no complication is severe enough and frequent enough to *not* operate upon these patients if it is clear that the disease is localized in the pelvis." In connection with the choice of radiation over surgery for recurrent disease, Schmitz and Gajewski (2) have written: "certainly mention must be made of this approach prior to any discussion of procedures that glibly deal with wet colostomies, urinary pouches, and skin ureterostomies. Re-irradiation, with the ever attendant danger to bladder and rectum, should not be considered as having failed if the patient, cured of disease, sustains vesical or rectal fistulas as an aftermath of therapy. These too can be treated surgically."

FINAL RESULTS

The absolute five-year survival, with no evidence of cancer following retreatment was 16 per cent (7 out of 44 cases). This figure excludes 2 patients who are alive and well but without histologic confirmation of recurrence, but includes 12 fatal cases in which the recurrence was not histologically verified. Inclusion of the 2 favorable cases would raise the survival rate to 19 per cent. In the 30 cases comprising Class A (without massive pelvic or extrapelvic involvement), the salvage rate was 23 per cent. If the 2 cases of survival without biopsy are included, this figure is

increased to 28.1 per cent. In the group with positive biopsy, the overall salvage rate was 21.9 per cent. For the 24 Class A patients with positive biopsies, the salvage rate is 29.2 per cent. The average length of life after retreatment in the fatal cases was thirteen months, the longest period being forty-one months. Many of the patients experienced subjective and objective palliation.

Eleven of the patients who died were retreated for recurrence that was at first grossly evident in the cervix or in immediately contiguous vaginal tissue. According to the original clinical staging, 1 of this group had Stage I disease, 7 Stage II, and 3 Stage III. Three of the Stage II cases and the Stage I case subsequently received a second retreatment. The average length of life after first retreatment in these 11 cases was twenty months (with a range of two to forty-one months) and after primary irradiation, thirty-four months (with a range of fifteen to sixty-seven months).

Seven patients who died (2 in Stage I, 4 in Stage II, 1 in Stage III) received a second retreatment and lived an average of fifty months following primary irradiation (range, nineteen to ninety-nine months), and twenty-two months after the first retreatment. The retreatment in these cases was as follows:

1. Four cases, radium first and x-ray second (intervals: twelve, twenty-nine, twelve, and one months).

2. Two cases, x-ray first and radium second (intervals: seventeen and three months).

3. One case, combination of x-ray and radium first, and radium second (interval: twelve months).

Brunschwig (3) reported a series of 51 cases of carcinoma of the cervix in which initial radiation therapy given in an attempt to cure (original stage of cancer, amount of radiation, and other technical factors not stated) was followed by extended surgical procedures for recurrent or persistent cancer. Fourteen of his patients had lived without evidence of cancer

for periods between four years and five years and ten months (27.4 per cent). The clinical classification of these cases is based upon the operative and pathologic findings, and comparison with the present study in which patients were handled wholly by irradiation is therefore difficult. The best results were obtained when disease was limited to the cervix, lower uterine segment, and upper third of the vagina (7 out of 15 cases, 46.6 per cent). When the parametria, ovaries, pelvic lymph nodes, rectum, or bladder were involved, the salvage was 7 of 36 patients (19.4 per cent). With certain qualifications, these 51 surgical cases are to some extent comparable to the 24 Class A cases with positive biopsy treated at the Roswell Park Memorial Institute, of whom 29.2 per cent have survived without cancer for five or more years after re-irradiation.

Comparison of two small samples, however, especially when all pertinent factors such as age, selection, etc., are not known, is inaccurate and without statistical significance. One would want to know the comparable functional results, both physical and psychological, in the groups treated by either method.

It should be stated that in few of the re-irradiated patients was hospitalization possible for periods longer than was necessary for radium application. Every observant radiotherapist is aware that some patients die as a result of inadequate medical and nursing care during the post-irradiation recovery period.

SUMMARY

1. Forty-six patients with cancer of the cervix, recurrent or persistent after an intensive radiation regime, were re-irradiated. Of these, 9 were alive and without cancer more than six years following retreatment.

2. Positive biopsies of the retreated disease had been obtained in 7 of the 9 surviving patients and in 25 of the 37 patients who died.

3. Retreatment was either by x-ray or radium alone, or by the two combined.

4. In 9 salvaged cases and in 23 of the 37 fatal cases disease was limited to one or more of the following areas: cervix, vagina, bladder, rectum, parametrium (not of the massive or frozen pelvis type).

5. For the 32 patients without massive fixed pelvic or extrapelvic disease, the eventual five-year salvage was 28.1 per cent. For 24 patients in this group with positive histologic confirmation of recurrence, the eventual salvage was 29.2 per cent.

6. For the fatal cases, the average survival time after retreatment was thirteen months, the longest period being forty-one months. The average period of survival after the initial course of radiation was thirty months.

7. In the 9 surviving patients complications were as follows: proctitis, 1; cystitis, 1; proctitis and cystitis, 1; recto-vaginal fistula, 2. All patients were active and relatively comfortable at the time of the report.

8. The following conclusions are reached. Re-irradiation of a patient with cancer of the cervix which recurs after an initial intensive radiation regime is an indicated and hopeful procedure, especially when pelvic involvement is limited and the patient is otherwise in good physical condition. The end-results, both as to longevity and function, appear to compare favorably with those afforded by present surgical practice. Complications, which are calculated risks, may be minimized by the alert application of medical and nursing care.

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SUMARIO

Los Resultados de la Re-Irradiación en el Cáncer del Cuello Uterino

Cuarenta y seis enfermas con carcinoma escamocelular que recurrió o persistió a continuación de un intenso régimen irradiatorio, fueron re-irradiadas. De ellas, 9 se hallaban vivas y sin cáncer más de seis años después del re-tratamiento. Se han obtenido biopsias positivas de la enfermedad re-tratada en 7 de las 9 sobrevivientes y en 25 de las 37 enfermas que fallecieron. El re-tratamiento fué ya con los rayos X o el radio solos o con una combinación de los dos métodos.

En los 9 casos salvados y en 23 de los 37 letales, la dolencia estaba limitada a una o más de las siguientes zonas: cuello uterino, vagina, vejiga urinaria, recto, parametrio (no del tipo masivo o de pelvis congelada).

Entre las 32 enfermas sin enfermedad pelviana o extrapelviana de tipo fijo masivo, la sobrevivencia eventual de cinco años representó 28.1 por ciento. Para las 24 enfermas de este grupo con confirma-

ción histológica de la recurrencia, la sobrevivencia eventual representó 29.2 por ciento.

Para los casos letales, el tiempo medio de sobrevivencia después del re-tratamiento fué de trece meses, llegando a cuarenta y un meses el período más largo.

En las 9 sobrevivientes, hubo las siguientes complicaciones: proctitis, 1; cistitis, 1; proctitis y cistitis, 1; fístula recto-vaginal, 2.

La re-irradiación de una enferma que tiene cáncer recurrente del cuello uterino, a continuación de un intenso régimen inicial de irradiación, es un procedimiento indicado y prometedor, sobre todo cuando la enfermedad pelviana está limitada y la enferma se halla, aparte de esto, en buen estado físico. Los resultados terminales, tanto en cuanto a longevidad como función, parecen compararse favorablemente con los ofrecidos por la actual práctica quirúrgica.

Fracture of the Promontory of the Calcaneus¹

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THOUGH THE subject of fractures of the calcaneus has been extensively covered (1, 5, 11, 12, 13, 14, 17, 20, 21), our attention has been directed, within the past few months, to a simple calcaneal fracture which to our knowledge has received slight attention in the literature, yet is important clinically and from the medicolegal aspect. Only a few writers (2, 7, 8) have reported small series of cases briefly describing the anatomy and mechanism of this fracture.

The portion of the calcaneus involved appears never to have been given a specific anatomical name, though it rightly deserves one. Textbooks of anatomy (6, 10, 19) describe the calcaneus (*os calcis*) as having on the anterior surface a saddle-shaped facet which articulates with the cuboid bone. On the medial surface at the anterior superior margin is a facet known as the anterior articular surface, which articulates with the anterior calcaneal facet of the talus. Yet the entire anterior superior margin of the calcaneus, especially as seen on the lateral or oblique roentgenogram, presents a definite ledge-like appearance. Arbitrarily, we have named this portion the *calcaneal promontory*. Several ligaments have their point of attachment along this ledge, principally the bifurcated ligament, which sends fasciculi to the cuboid and to the navicular bones, and the dorsal calcaneocuboid ligament, which connects the calcaneus and the cuboid superiorly.

The mechanism inducing fracture of the calcaneal promontory seems to be (1) a combination of inversion with plantar flexion or (2) acute dorsiflexion of the foot. A "rolling" type of injury is often sustained, in which the long arch of the foot is acutely "cupped" over an object. The separation of the fragment probably depends primarily on the tensile pull of

the ligamentous attachments. Evidently there is a sudden increase in tension on the bifurcated ligament and the dorsal calcaneocuboid ligament which pull the promontory from the main bone. Another factor which probably contributes to the fracture is the leverage effect of the posterior superior margin of the cuboid on the overhanging ledge-like promontory of the calcaneus when the foot is forced into abrupt exaggerated dorsiflexion.

ROENTGEN ASPECTS

The roentgen differentiation of several entities (3, 4, 9, 13, 18) presents medicolegal overtones. A recent fracture offers no difficulty from the roentgenologic standpoint. The features of dehiscence of bone, with loss of continuity of the cancellous structure, and separation of the "beak" fragment are demonstrable, while the fractured surfaces show rather distinct frayed margins with absence of cortex in this area. When a separate ossicle is noted at the site of the calcaneal promontory, it must be determined whether it is (a) a calcaneus secundarium, (b) a fragment of fractured bone with non-union and ossicle formation, or (c) possibly an ununited epiphysis.

Köhler (13) mentions the tendency to formation of independent ossification nuclei about the *os calcis*, which may account for the accessory sesamoid, the calcaneus secundarium. With the presence of this latter anomaly, the calcaneal promontory and a part of the body of the *os calcis* are still evident. Most accessory sesamoids, including the calcaneus secundarium, are round or ovoid in shape, with cortex sheathing the bony density. A fragment of bone fractured at this location with non-union and ossicle formation tends to have a more triangular appearance and there may be cortex completely surrounding the fragment. When the surface of an adjacent

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ossicle parallels the opposing surface of the calcaneus and the two pieces of bone closely conform to the configuration of the normal promontory, one can, with some assurance, assume that the separate fragment represents a fracture with non-union. A review of the literature (4, 9, 13, 18) revealed no mention of a secondary epiphyseal center at this location, which precludes any possibility of an ununited epiphysis.

and had noted increasing discomfort in the mid-portion of the injured foot, along the long arch.

Radiographs revealed a pea-sized ossicle at the anterior superior margin of the calcaneus, evidently the result of an old injury, with condensation and roughening at the adjacent surface of the main portion of the os calcis (Fig. 1). The tangential view of the calcaneus did not show the ossicle with any clarity. A comparison view of the opposite foot revealed no similar ossicle in the corresponding location.

The patient was advised to obtain arch supports,



Fig. 1. Case I. Note the well-defined ossicle at the anterior superior margin of the calcaneus which is the promontory portion.

Post-traumatic amorphous calcifications may occur and were seen in one case. The fracture had healed, but calcified flecks appeared in the bifurcated and dorsal calcaneocuboid ligaments. To our knowledge this is the first mention of deposits of calcium occurring at this site on a post-traumatic basis. In a previous paper, we have discussed the theories of the formation of abnormal calcifications (16).

Neither the routine anteroposterior view of the foot nor the plantar-dorsal axial (tangential) view of the calcaneus demonstrated any of the fresh fractures or the non-union ossicles in the cases reported.

Ten cases have been collected from the author's practice, of which 3 representative of the group are presented.

CASE I: W. F. H., white male, age 44, while serving in the Army in 1943, was requested to run the "obstacle" course. During this procedure he jumped from a high barrier to the ground, a distance of approximately 15 feet, suffering an injury to his left foot of the dorsiflexion type, causing acute pain in the middle of the foot. The pain was severe and was protracted for several months, gradually subsiding to a state of mild discomfort. In the past year, the patient had been playing golf frequently

with particular emphasis on weight-bearing of the long arch. Surgery was suggested but declined.

CASE II: P. G., white male, age 27, was unloading merchandise from a semi-trailer truck while standing on a loading platform. He stepped down from the 4-foot dock and his left foot encountered the edge of a wood block, undergoing an inversion twisting motion which projected him under the trailer. Pain in the ankle and foot was excruciating and, on arising and attempting to walk, the patient "blackened out." He was sent to the hospital and an x-ray examination of the ankle revealed "a fissure fracture of the anterior superior margin of the calcaneus with no displacement" (Fig. 2). Clinical examination showed swelling of the left ankle and foot with marked tenderness on the plantar aspect, somewhat posteriorly. Plantar flexion increased the pain, but it was only slightly aggravated by dorsiflexion, inversion, and eversion.

Four months later, a re-check radiograph showed "non-union of the chip fragment of the os calcis at the superior anterior margin, with separation of the fragment and widening of the space on the superior aspect of the fracture line." The fractured margins were described as "somewhat sharply outlined, with no evidence of callus" (Fig. 3). The patient complains of little discomfort except on extreme plantar flexion of the injured foot.

CASE III: B. D., white female, age 46, while cleaning walls with a broom, was standing on a pile of lumber, which buckled, throwing her to the floor.



Fig. 2. Case II. The fissure fracture of the calcaneal promontory is quite evident and the fragment is in good position.



Fig. 3. Case II. Four months after the initial film, non-union has resulted, with ossicle formation. The separate fragment is slightly tilted.

She suffered a twisting injury to the left foot and ankle and was hospitalized. Roentgenograms disclosed "a transverse fracture across the anterior superior margin of the os calcis at its articulation anteriorly and inferiorly with the talus. There was no evidence of displacement of the fragment" (Fig. 4). Ice compresses were used, and two days later a "walking" plaster cast was applied. After two weeks, because of extreme pain, the cast was removed and a herpetic type of dermatitis was found. Roentgenograms at this time revealed evidence of fracture healing.

Another roentgenogram was obtained seven weeks after the initial examination. The report read: "The fracture of the promontory of the left os calcis is fairly well healed. A spotty decalcification of the bones is noted, apparently due to disuse. Several amorphous deposits are seen at the tip of the promontory fragment." The patient still complained of distress in the mid-tarsal area of the foot.

Two and a half months later, further roentgenograms were obtained because of persistent pain, especially on weight-bearing. The findings were reported as follows: "Healed fracture of the calcaneal promontory tip with evidence of amorphous calcified deposits at the tip of the promontory. These deposits are probably post-traumatic in origin and ligamentous in location" (Fig. 5).

DISCUSSION OF DISABILITY

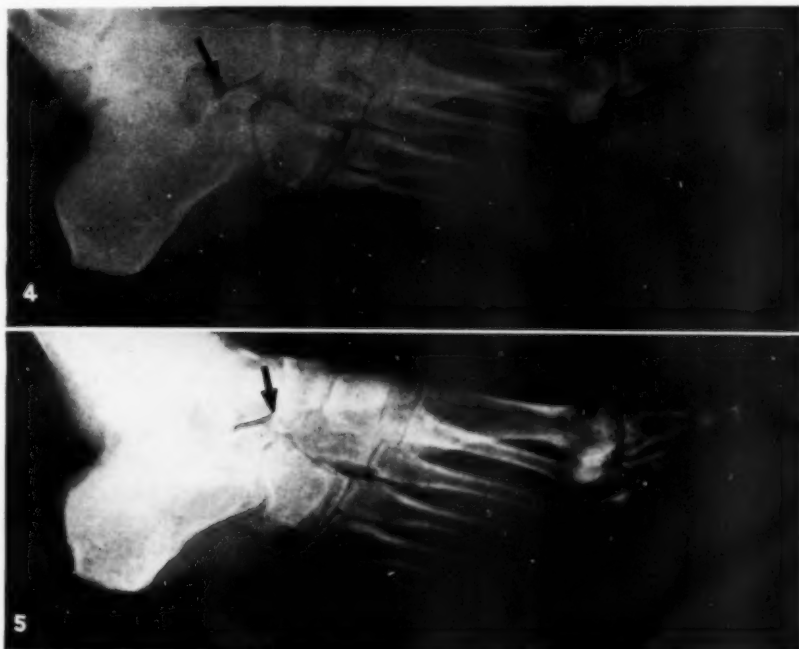
Disability from a simple healed fracture of the calcaneus may last from seven and a half weeks to six months (2, 7, 8, 15), depending on the type of treatment instituted. In only 1 of our cases which had good union was there any lasting functional disability, amounting to approximately 5 per cent, and this was attributed to post-traumatic calcifications.

A fracture with non-union presents another problem of disability evaluation. McBride (15) points out that the longitudinal arch of the foot rests on the os calcis and the metatarsal heads, especially the third. With the calcaneal promontory as a separate ossicle, one would expect some instability and flattening of the long arch, since there is a loss of continuity of the structural support. The anterior half of

the calcaneus would tend to sag, especially with the act of stepping, which shifts the weight from the outer to the inner aspect of the foot, influenced to some extent by the weight of the individual. Computing the disability from McBride's criteria (15), one would feel that the maximum

SUMMARY

The name "calcaneal promontory" is arbitrarily applied to the anterior superior margin of the calcaneus, which is seen as a ledge-like structure on lateral and oblique roentgenograms. Ten cases of fracture involving this part of the calcaneus have been



Figs. 4 and 5. Case III. In Fig. 4 the recent fracture of the calcaneal promontory can readily be seen in excellent position. Fig. 5 reveals amorphous deposits of calcium at the tip of the calcaneal promontory four months later. The fracture of the promontory is healed.

limit for this condition should not exceed 15 per cent. In 1 of our cases with non-union, disability was less than 2 per cent. The remaining 2 cases which showed ossicle formation after non-union on the original roentgen examination presented minor disability, which did not exceed 10 per cent.

Jaekle and Clark have indicated that fractures into the calcaneocuboid joint are relatively unimportant and that disability is practically nil. We are not entirely in accord with this opinion in view of the apparent frequency of non-union, as well as the possibility of post-traumatic calcifications in healed fractures.

collected and 3 case reports are presented.

Roentgen diagnosis of a recent fracture of this type presents no difficulty. With non-union and ossicle formation, differentiation from an accessory sesamoid, the calcaneus secundarium, must be made.

With healed fractures, disability is seldom prolonged, lasting from seven and a half weeks to six months. The maximum limit of disability in cases of non-union is placed at 15 per cent.

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SUMARIO

Fractura del Promontorio del Calcáneo

Aplicase arbitrariamente el nombre de "promontorio del calcáneo" al borde anterosuperior de dicho hueso, que aparece en forma de banco o arrecife en las radiografías laterales y oblicuas. Se han compilado 10 casos de fractura que afecta esta parte del calcáneo y se presentan 3 historias clínicas.

El diagnóstico radiológico de una fractura reciente de este género no entraña dificultad. Cuando no existe unión y hay

formación de huesecillos, hay que hacer la diferenciación de un sesamoides accesorio, el calcáneo secundario.

En las fracturas cicatrizadas, la incapacidad es rara vez prolongada, durando de siete semanas y media a seis meses. El límite máximo de incapacidad en los casos sin unión se fija en 15 por ciento. En uno de los casos del A., fué de menos de 2 por ciento y en otros 2 de menos de 10 por ciento.



Mediastinal Carinal Bronchogenic Cysts¹

JAMES G. DAVIS, M.D.,² and JOHN H. SIMONTON, M.D.³

BRONCHOGENIC cysts are of congenital origin, arising from the tracheobronchial tree. Although they were once considered rare entities, many have recently been discovered in mass roentgenographic surveys of the chest.

Mediastinal bronchogenic cysts are believed to originate in an abnormality in the development of the tracheobronchial tree. The primitive foregut gives rise to the respiratory tract and to the esophagus, the dorsal segment forming the esophagus, while the ventral component forms the trachea. Bronchogenic cysts occur when there is abnormal budding or branching of the tracheobronchial tree. The majority of the cysts are in relation to the trachea or to the main bronchi.

Maier has given an acceptable classification of bronchogenic cysts as follows:

- (1) Paratracheal
- (2) Carinal
- (3) Hilar
- (4) Paraesophageal
- (5) Miscellaneous

We are limiting our discussion in this paper to carinal bronchogenic cysts, reporting 3 cases.

Pathology: Carinal bronchogenic cysts are usually single, rarely lobulated, thin-walled spherical masses, containing mucoid material varying from a white to a dirty brown in color. The lining is usually ciliated columnar epithelium, although it may be cuboidal. The cyst wall may contain mucous glands, cartilage, elastic tissue, and smooth muscle (Fig. 1). Secondary infection may destroy the mucosal lining. Communication with the tracheobronchial tree occurs only rarely.

Clinical Findings: The clinical course

depends upon the location and the presence or absence of infection. Many of the cysts produce no symptoms. Pain, usually substernal, may occur. Cough from tracheobronchial irritation is fairly common. If the cyst is sufficiently large, it may exert pressure on the respiratory tract or the esophagus, causing bronchial obstruction, chronic respiratory infection, or dysphagia. With infection of the cyst, symptoms of pulmonary suppuration may occur.

Roentgen Findings: Mediastinal carinal bronchogenic cysts are located near or just beneath the bifurcation of the trachea. They are ovoid or round, homogeneous in density, and usually well circumscribed. Rarely, they may show air-fluid levels if they have a bronchial communication. The shape may change with inspiration and expiration.

On the postero-anterior view of the chest, the cyst is usually seen overlying the heart shadow and projecting more often to the right hilar area. On oblique and lateral views, it is usually posterior to the heart in the carinal region. The right and left main stem bronchi may be spread apart by the cyst. It may displace the esophagus. Frequently it moves with coughing or swallowing.

Differential Diagnosis: Dermoids and teratomas are to be considered in the differential diagnosis. Usually these are in the anterior mediastinum and they may be calcified. Thymomas also tend to occur in the anterior mediastinum and are often lobulated. Lymphomas are as a rule lobulated and confined to the lymph-node areas. An enlarged left auricle may give a similar appearance on the postero-anterior film. Bronchogenic cysts, however,

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are usually higher in location, and the characteristic posterior displacement of the esophagus by the enlarged left auricle is usually absent.

Aortic aneurysm may be suspected, but in the oblique and lateral views the cyst can usually be separated from the aorta. Angiocardiography will prove useful in such cases.

past history, physical examination, and laboratory studies were non-contributory.

Roentgenograms of the chest (Figs. 2 and 3) revealed a large subcarinal mediastinal mass lying posterior to the heart, extending out to the right hilar area and causing a widening of the bifurcation of the trachea. No pulsations were seen on fluoroscopy. Cardioangiography showed non-filling of the mass.

On thoracotomy, June 29, a subcarinal cyst was found, measuring 10 cm. in diameter, lying in the mediastinum posterior to the heart and containing



Fig. 1. Case I. Photomicrograph showing ciliated columnar epithelium lining the interior of the cyst and cartilage in the wall.

Esophageal and gastric cysts are similar to bronchogenic cysts but are usually more posterior in location. Neurogenic tumors occur posteriorly and may produce erosion of either the spine or the ribs. A paraspinal abscess might simulate a bronchogenic cyst on the postero-anterior view, but lateral spine films will show vertebral destruction. Pericardial cysts are usually anterior in location and lower in position in the chest. Bronchogenic carcinomas, as a rule, are less sharply outlined than carinal cysts.

CASE REPORTS

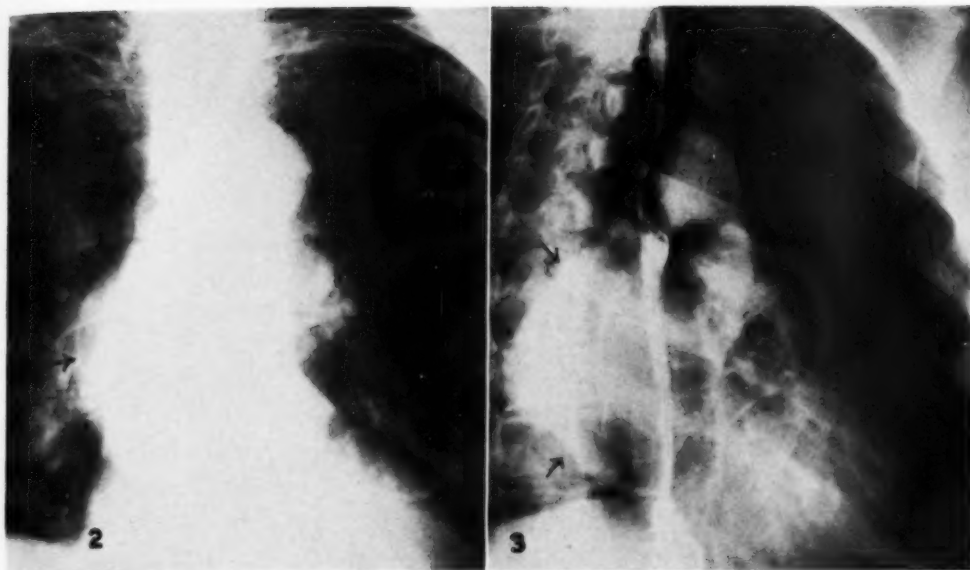
CASE I: P. C., a 63-year-old white male, was admitted on June 8, 1950, complaining of a catching pain in the right posterior chest, associated with deep inspiration, and a chronic productive cough. The

300 c.c. of a mucoid material. Only about one-half of the cyst could be removed because of adherence to the right main stem bronchus and pulmonary vessels. Two months later the remaining portion was excised.

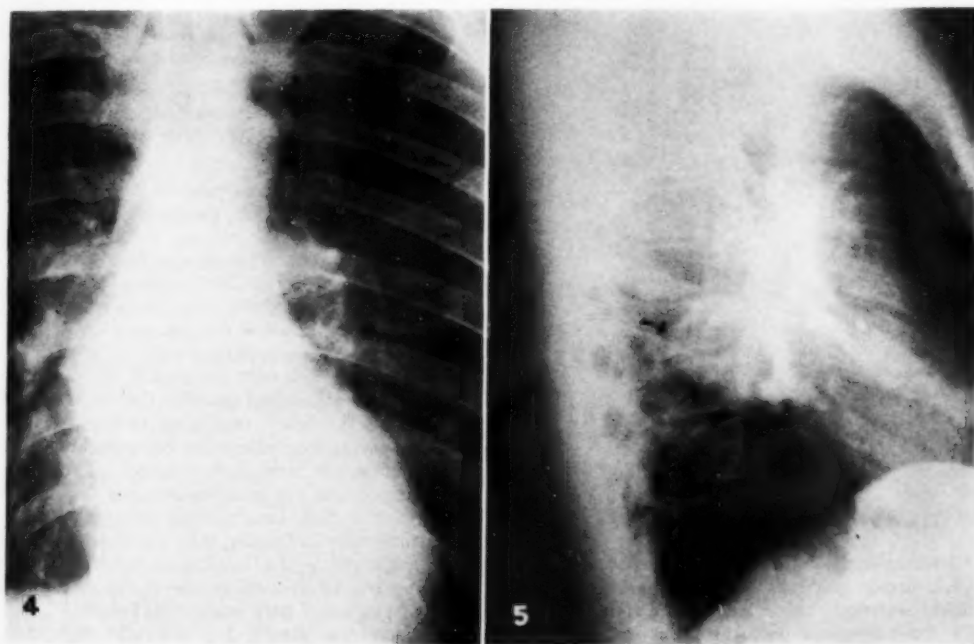
On microscopic examination the cyst was found to have a partial lining of ciliated epithelium and bits of cartilage within its wall (Fig. 1). The latter showed fibrosis and areas of organizing fibrinoid material, surrounded by a zone of subacute and chronic inflammation. *Diagnosis:* Bronchogenic cyst.

CASE II: P. I. K., a 30-year-old white male, admitted on April 20, 1951, was referred for evaluation of a mediastinal mass discovered in a chest x-ray survey four months previously. He denied any symptoms. The past history, physical examination, and laboratory data were non-contributory.

Chest films (Figs. 4 and 5) showed a subcarinal mass lesion, 8 cm. in diameter, posterior to the heart. The radiological impression was a possible bronchogenic cyst.



Figs. 2 and 3. Case I. The postero-anterior view (Fig. 2) shows the mediastinal carinal bronchogenic cyst projecting out into the right hilar area. In the right anterior oblique projection (Fig. 3) the cyst is seen posterior to the heart.



Figs. 4 and 5. Case II. The postero-anterior view (Fig. 4) shows the cyst projecting in the right hilar area. In the lateral view (Fig. 5) the cyst is seen to be posterior to the heart.



Figs. 6-8. Case III. In the postero-anterior view (Fig. 6) the carinal mediastinal cyst is shown projecting out into the right hilar area and widening the carinal angle.

The left anterior oblique view (Fig. 7) shows obliteration of the "aortic window" and the upward compression of the left main stem bronchus by the cyst, simulating an enlarged auricle.

In the right anterior oblique view (Fig. 8) the cyst is seen to be posterior to the heart, without producing posterior displacement of the esophagus.

CASE III: W. J. O., a 28-year-old white male, was admitted on Dec. 24, 1951, complaining of left subcostal pain for one week, radiating to the subxiphoid area and aggravated by swallowing food. A similar episode of less severity had occurred two years prior to admission, lasting two weeks. Otherwise the past history, physical examination, and laboratory studies were non-contributory.

Chest films (Figs. 6-8) revealed a 10×13 -cm. circumscribed subcarinal mass in the mediastinum posterior to the heart, producing widening of the carinal angle and elevating the left main bronchus. No pulsation was seen at fluoroscopy. The radiological impression was bronchogenic cyst.

Thoracotomy on Jan. 2, 1952, revealed a cystic subcarinal mass projecting into the right hilar region, compressing the esophagus posterolaterally, widening the bifurcation of the trachea, and producing elevation of both main stem bronchi.

The mass was attached to the right main stem bronchus by a small pedicle, which appeared to contain bronchial cartilage. However, no direct communication with the bronchial tree existed.

Thoracotomy on May 14 disclosed a subcarinal cystic tumor, posterior to the right hilus and attached superiorly to the right main stem bronchus. No communication with the bronchus was found. The cyst contained a thick yellow fluid.

Microscopic examination of the surgical specimen led to the diagnosis of bronchogenic cyst.

The contents consisted of 250 c.c. of thin, cloudy, grayish fluid.

Microscopic examination of the surgical specimen led to a diagnosis of bronchogenic cyst.

Treatment: Surgical excision should be done if at all possible in the interest of both accurate microscopic diagnosis and cure.

SUMMARY

Three cases of carinal bronchogenic cysts have been presented. The general features of these cysts are discussed.

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SUMARIO

Quistes Bronc6genos Carinales Mediast6nicos

Pres6ntanse 3 casos de quistes bronc6genos carinales del mediastino. Estos quistes se localizan cerca o precisamente debajo de la bifurcaci6n de la tr6quea. Son ovoideos o redondos, de densidad homog6nea y por lo general bien circunscritos. En una radiograf6a posteroanterior del t6rax, suele observarse el quiste superpuesto a la imagen card6aca y proyectando m6as a menudo a la zona del hilio derecho. En las vistas oblicuas y laterales suele observarse detr6s del coraz6n en la regi6n de

la quilla. Las principales ramas derecha e izquierda de los bronquios pueden ser separadas por el quiste y el es6fago puede quedar desplazado. Hay que diferenciar los quistes y teratomas dermoideos, el timoma, el linfoma, la hipertrofia de la aur6cula izquierda, los quistes esof6gicos y g6stricos, los tumores neur6genos, el absceso pararraqu6ideo, el quiste pericard6aco y el carcinoma bronc6geno. En aras del diagn6stico exacto y de la curaci6n, se recomienda la excisi6n quir6rgica.



Cervical Disk Calcification in Childhood¹

WILLIAM G. PEACHER, M.D. and RICHARD P. STORRS, M.D.

CALCIFICATION of the cervical intervertebral disks is relatively uncommon. It is usually observed in childhood. The incidence, etiology, anatomy, and physiology have been thoroughly reviewed by Weens (3) and Silverman (2). The latter collected 5 cases previously recorded in the literature, adding 2 of his own. We have felt it worthwhile to report an additional example to call further attention to the problem. Our case is of interest also because of the long follow-up (almost three years).

CASE REPORT²

F. D., a 5-year-old boy, was admitted to St. Joseph's Hospital on Nov. 17, 1952, because of pain of three days duration over and to the right of the posterior cervical spine, following a fall from a sofa. There were associated burning in the right pharynx and discomfort on attempted movement of the neck to the right.

The patient was born in St. Joseph's Hospital at term (breech delivery) on Nov. 26, 1947. Mild atelectasis was present but improved on conservative treatment. A roentgenogram taken on Dec. 1, 1947, revealed a slight mediastinal shift with narrowing of the trachea. No calcification of the cervical intervertebral disks was noted.

From March 27 through April 2, 1949, the child was hospitalized for diarrhea and marked dehydration, attributed to acute enterocolitis. There was moderate elevation of temperature for a period of five days, with a peak of 102.4°. Recovery, on a conservative regime, was uneventful.

The developmental history was within normal limits, with an average of one attack of tracheitis and upper respiratory infection per year, lasting for about a week. In the course of one of these episodes, in July 1952, pain was experienced over the right side of the neck. Examination was negative, however, aside from cervical lymphadenopathy and dental caries. Three teeth were extracted and the symptoms abated in a week. A similar episode occurred on Nov. 1 of the same year, again with cervical adenitis and a temperature of 102°, but with tonsillitis and herpes labialis in addition. Antibiotic therapy led to rapid improvement, and the boy returned to school on Nov. 10.

The parents, mother aged thirty-three and father thirty-nine, and one sibling, a girl of two and a half, were in good health. The familial history was not significant.

Physical examination showed marked limitation of motion of the cervical spine in all directions except to the left. There was pain on palpation over and to the right of the intervertebral spaces from C-3 to C-7. Dental caries was evident and an acute tonsillitis was present. There was slight cranial asymmetry, with flattening of the right frontal and facial bones, but the latter did not constitute a true facial hemiatrophy. Otherwise the physical and neurologic findings were essentially negative. There was no febrile reaction and the vital signs were consistently normal.

All laboratory data, including blood count, urinalysis, Wassermann test, throat smear and culture, sedimentation rate, etc., were within normal limits.

Roentgenograms of the cervical spine, Nov. 17, 1952, showed no evidence of fracture, dislocation, or bone disease. The cervical spine was rather erect, suggesting the possible presence of muscle spasm. In the oblique views, irregular calcific deposits were observed in the space between the fourth and fifth cervical vertebrae. The calcification was less evident in the lateral projections. There was slight narrowing of the intervertebral space between C-4 and C-5.

Re-examination, Nov. 22, still showed the shadow of calcific density at the fourth interspace, with associated narrowing. No other abnormality was observed.

The child was placed in cervical traction, with a halter, supplemented by bed rest, fracture boards, physical therapy, and the usual supportive measures. Rapid improvement followed and he was discharged from the hospital on Nov. 24. Further progress, through July 18, 1955, has been uneventful, with no complaints referable to the cervical spine or coincidental problems. Subsequent x-ray studies have been carried out with the following observations:

Dec. 20, 1952: No change in the calcification of the fourth intervertebral disk previously noted. Narrowing of the interspace, however, was no longer observed.

Feb. 16, 1953: An approximate 50 per cent reduction in the previously noted calcification at the fourth disk.

June 30, 1953: No change.

March 4, 1954: Much less calcification than at the

¹ Accepted for publication in October 1955.

² The attending orthopedic surgeons, Drs. Mark Harwood and Charles Linhart, have kindly given the writers permission to evaluate and study this case.

last examination. The intervertebral space appeared normal.

Aug. 23, 1954: Calcification in the intervertebral disk between the fourth and fifth cervical vertebrae still present, in approximately the same amount as on the last examination.

July 18, 1955: Minimal calcification in the disk between C-4 and C-5, considerably less than at the previous examination.

COMMENTS

Calcified cervical disks, though uncommon in children, are of more frequent occurrence than in adults. In the older group, disk changes are much more likely

deposits. Silverman pointed out that calcified cervical disks may be present in childhood without x-ray changes, which is no doubt true, although the majority of such cases have probably not been referred for roentgenologic examination. It is possible, therefore, that the condition is more common than heretofore believed.

Silverman, Weens, and others have felt that calcification in the cervical region is transient. Actually this is a relative term, since the calcific changes continue to be evident for at least two to three months

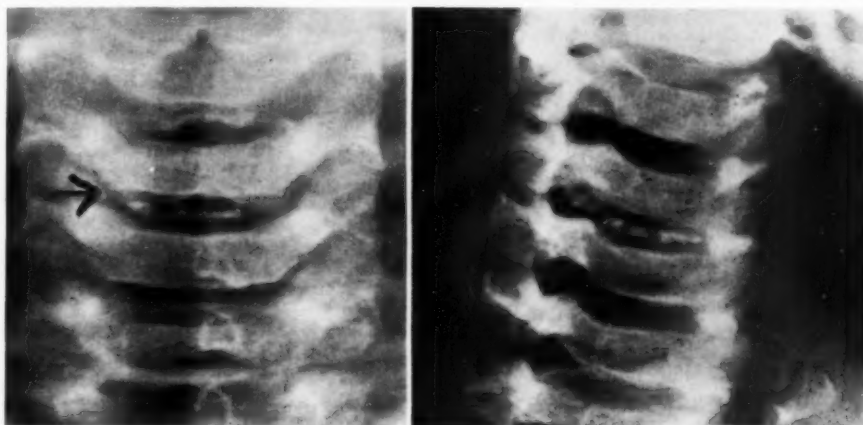


Fig. 1. Localized views of cervical spine showing calcification between C-4 and C-5.

to be the result of degeneration with osteoarthritis and occasional protrusion, with associated radiculitis and objective neurological signs. Calcification is usually not evident. In children, calcification has been most commonly found in males (7 of the 8 reported cases), although the limited number of cases thus far reported makes accurate statistical computation unreliable.

The condition is commonly associated with subjective pain and discomfort, limitation of motion, and muscle spasm, with occasional deformity. An acute febrile reaction is not uncommon, together with other evidence of a primary acute infection. There is no apparent correlation between the regional symptoms and the extent and localization of the calcium

in the average case, and have been known to persist for longer periods, although decreased in amount. Silverman believed that the fact that permanent calcification had not yet been described was the only good reason to consider the cervical cases separately.

Weens suggests that there are certain differences between calcification of the disks in childhood and adulthood.

1. Four of 6 collected cases in children were localized to the cervical region, suggesting a predilection for this area in childhood as contrasted with the greater frequency of lower dorsal and upper lumbar involvement in adults.

2. Disk calcification in adults is usually stationary, whereas in 5 of 6 cases reviewed by Weens there was rapid change

in the size of the calcific deposits, or complete absorption.

The high vascularity of the intervertebral disk in childhood renders it especially susceptible to systemic infection with residual calcification. Paradoxically, the lack of blood supply in advancing years also predisposes to the laying down of calcium, which may be permanent. Sandström (1) differentiated peripheral and central disk calcification, asserting the former to be permanent and the latter transient.

SUMMARY

The case of a child with calcification of the fourth cervical disk, followed for three years, has been presented. Although the small number of cases reported makes statistics unreliable, this condition often appears to follow an acute inflammatory process. Symptoms referable to the cervical spine—pain, limitation of motion, muscle spasm, etc.—with or without evidence of a focus of infection and systemic reaction, usually occur. Conservative and symptomatic care are generally sufficient to bring about early subjective relief with no permanent residuals. The calcific deposits have been found to last for varying periods of time.

ADDENDUM

A second case of cervical disk calcification in childhood was observed on March 21, 1956, after acceptance of the present paper for publication.

C. L., a previously well 4-year-old boy, was admitted to St. Joseph's Hospital with a history of severe pain in the neck, of insidious onset, and anorexia of seven days duration. The physical and neurologic examinations were negative aside from restricted motion of the cervical spine, more evident on left lateral flexion, and tenderness and spasm of the right sternomastoid muscle. The vital signs and laboratory studies were normal. Roentgenograms of the cervical spine taken on March 21 revealed no evidence of fracture or dislocation. There was loss of the normal lordosis, and the spine was held in a partially flexed position, with slight scoliosis to the left. In the disk between the third and fourth cervical vertebrae were multiple small calcium deposits. The intervertebral space was not narrowed and the other disks were normal.

The child improved on routine conservative and symptomatic treatment, including mild sedation, analgesics, and physical therapy. Cervical traction was not tolerated. He was discharged, improved, on March 24. He has been asymptomatic since that date and was physically and neurologically normal on the last date of examination, July 14, 1956. Roentgenograms of the cervical spine taken then showed the calcification between the third and fourth cervical bodies to have almost entirely disappeared. There was no other indication of disease.

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SUMARIO

Calcificación de Disco Cervical en la Niñez

Comuníquese un caso de calcificación de un disco cervical en un niño, mantenido en observación desde la edad de cinco a la de ocho años. Aunque los pocos casos de la literatura no permiten sacar conclusiones fidedignas estadísticamente, parece que la dolencia sigue a menudo a un proceso inflamatorio agudo.

Suele haber síntomas—dolor, espasmo muscular, limitación de la movilidad, etc.—

imputables a la zona afectada del raquis, con o sin signos de un foco infeccioso y reacción orgánica. La asistencia conservadora y sistemática basta en general para obtener alivio subjetivo temprano, sin residuos permanentes. Se ha observado que los depósitos calcíficos persisten durante periodos variables de tiempo, casi siempre algunos meses.

En un Apéndice preséntase otro caso.

Chronic Myelogenous Leukemia: Unusual Bone Changes in an Adult¹

DONALD G. CLEMENTS, M.D., and EDMOND H. KALMON, M.D.

DESTRUCTIVE bone changes are rarely found roentgenologically in adult patients with chronic myelogenous leukemia. The purpose of this brief report is to record a case with extensive lytic bone lesions.

Craver and Copeland (1) in 1935 studied 169 cases of leukemia, of which 82 were of the myelogenous type. Only 1 of the 82 patients showed osseous involvement. Doub and Hartman (2) in the same year presented the case of a seventeen-year-old white male with widespread bone lesions, but who had an acute illness associated with bilateral exophthalmos and green soft-tissue tumors. It is not our intention to consider any cases with chloroma or with myelogenous leukemia in the acute phase. Textbooks both of hematology (Forkner, 3; Wintrobe, 11) and radiology (Schinz, 9; Pugh, 4) stress the rarity of lytic bone lesions in adults with chronic myelogenous leukemia. Townsend (10), in 1939, described a single destructive lesion in the right pubis and ischium in a fifty-six-year-old white female with chronic myelosis. In 1940 Mendl and Saxl (5) reported the case of a fifty-seven-year-old male with a large spleen but with a normal peripheral blood count and smear. Small doses of radiation to the spleen caused it to shrink so that it was no longer palpable. After three years marked by periodic relapses, this patient experienced lumbar pain radiating into both thighs. Roentgenograms showed foci of destruction and a compression fracture of L-4. Blood counts were compatible with aleukemic myeloid leukemia. Pascucci (8), in 1942, reported 64 cases of chronic myeloid leukemia and mentioned 1 instance of lytic bone involvement. Meyer, Friedmann and Ginsberg (6), in 1943, described a fifty-two-year-old white female who had

been treated over a period of three years for chronic myelogenous leukemia. She sustained a spontaneous fracture of the right distal femur while in bed, and biopsy of this area showed mainly myeloblasts and myelocytes. In a case published by Nesbitt and Roth (7) in May 1955, a solitary destructive lesion in the upper end of the tibia was proved by needle biopsy and at autopsy to be due to myelogenous leukemia.

The 7 cases cited in the preceding paragraph are the only ones which could be found in English literature recording bone changes in adults with chronic myelogenous leukemia. No attempt was made to survey the literature in other languages. The scarcity of references in the *Index Medicus* is additional proof that lytic bone lesions in adult patients with this disease are by no means common.

CASE REPORT

A white woman was first seen on Sept. 17, 1951, at the age of 47 years, complaining of a left upper abdominal mass which had been present for at least two months. It extended 5 or 6 cm. below the costal margin and was slightly tender. It was thought to be the spleen. The peripheral lymph nodes were not remarkable. The initial blood studies showed 3,890,000 red blood cells, hemoglobin 10 gm., and a white blood cell count of 334,000, with 1 per cent lymphocytes, 10 per cent filamented polymorphonuclears, 40 per cent non-filamented polymorphonuclears, 1 per cent eosinophils, 7 per cent promyelocytes, 7 per cent basophilic myelocytes, 1 per cent eosinophilic myelocytes, 3 per cent myelocytes, 8 per cent myeloblasts, and 21 per cent metamyelocytes. Sternal marrow puncture showed a very cellular marrow with cells of the myelocytic series predominating. At this time it was felt the patient was in a subacute phase of myelocytic leukemia. She had undergone a hysterectomy five years earlier for uterine leiomyoma, and a left simple mastectomy four years earlier for cystic mastitis.

Treatment was with whole blood transfusions, urethane, and radioactive phosphorus. After three

¹ From the Department of Radiology, Oklahoma City Clinic and Wesley Hospital, Oklahoma City, Okla. Accepted for publication in October 1955.



Fig. 1. Anteroposterior and lateral views of the right hip, showing a large, ill-defined destructive lesion of the subtrochanteric region of the right femur. The cortex superiorly seems to be completely destroyed. This lesion in July 1953 measured about 4 cm. in length. It filled in almost completely following deep x-ray therapy, yet reverted to its original appearance with return of symptoms in May 1954. The views shown here were made May 4, 1954.

months of such therapy, the spleen had not receded in size, and the patient remained moderately anemic. On Feb. 17, 1952, her white blood cell count was 445,000.

On Feb. 11, 1952, deep roentgen therapy to the

spleen was begun. In eighteen days it received 627 r, measured in air, anteriorly, 350 r posteriorly and 300 r laterally. It rapidly diminished in size and was no longer palpable six weeks after completion of therapy. The patient became asymptomatic and remained so for sixteen months.

Because of this long remission, it was felt that a change of diagnosis to chronic myelogenous leukemia was justified. In July 1953, pain and tenderness were experienced in the region of the right hip, and roentgenograms showed a lytic lesion in the right femur at the level of the lesser trochanter, measuring about 2×4 cm. (Fig. 1). No other bone lesions were found. This area was treated with deep x-ray therapy, 1,200 r (in air) to each of two opposing portals. The focal pain subsided rapidly. The peripheral blood studies were normal throughout this period, and the spleen was not palpable.

In January 1954, pain occurred in the left lower ribs, and a tiny lesion, 4×6 mm., was discovered in the left tenth rib. The pain disappeared rapidly with local roentgen therapy.

In April 1954, the patient began complaining of backache. Films of the lumbar spine (Fig. 2) showed a large area of destruction involving the spinous process and laminae of L-2, plus the right facets between L-2 and L-3. The peripheral blood remained normal, and the spleen was not palpable. The tissue removed seven years previously by a simple left mastectomy was reviewed and no evidence of malignancy was found. A needle biopsy of the spinous process of L-2 was attempted, but the results were inconclusive. Deep x-ray therapy was then instituted over the lumbar spine, and again prompt relief of pain was attained.

In June 1954, there was a rapid development of generalized pain with the appearance of many lytic lesions in the skull, shoulder girdles, ribs, and pelvis. The posterior neural arch lesion at L-2 and L-3 had filled in completely with new bone and was almost normal radiographically. Repeated peripheral blood counts and sternal marrow studies showed no evidence of myelogenous leukemia. The spleen had not enlarged. Since the bone lesions resembled metastatic carcinoma, particularly metastatic breast carcinoma, the patient was given testosterone propionate, 100 mg. intramuscularly, three times a week. Her general condition remained good, and the most painful bone lesions were treated with deep x-ray therapy. In spite of many transfusions, it was impossible to maintain the blood counts at or near normal levels. On July 17, 1954, the white count was 4,150, and the red count 2,620,000. On Aug. 6, the white count was 300; on August 17, it was 450; on August 21, it was 850; and on Sept. 3, it was 2,300. Terminally, the patient was comatose for four days, after a series of generalized convulsions. She died Sept. 7, 1954. Autopsy was performed by Dr. W. F. Keller, pathologist.

Significant postmortem findings were surpris-

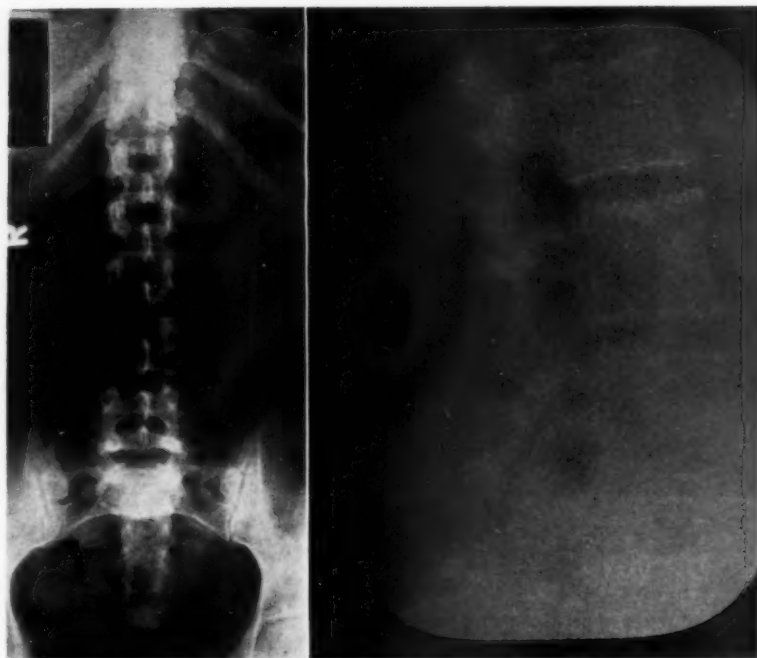


Fig. 2. Anteroposterior and lateral films of the lumbar spine taken on April 10, 1954. There is complete destruction of the right lamina of L-2 with extension of this lesion into the base of the spinous process of L-2. This area filled in almost completely following deep x-ray therapy and did not recur.

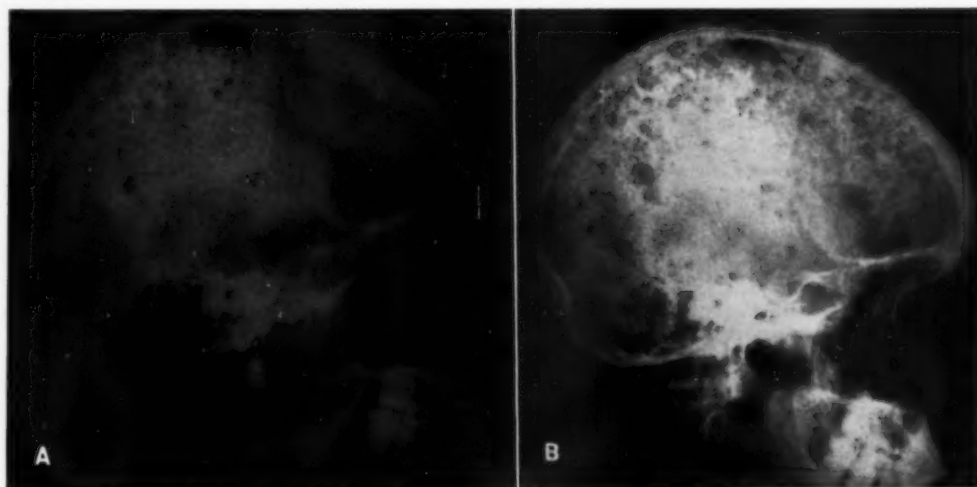


Fig. 3. Lateral films of the skull. A. Roentgenogram taken on June 22, 1954, showing numerous, discrete, rounded and oval lesions of the skull, primarily involving the frontal and parietal bones. The sharpness of the outlines of these lesions is similar to that frequently seen in multiple myeloma. B. Roentgenogram taken on July 21, 1954, showing marked progression of the destructive bone lesions.



Fig. 4. Anteroposterior view of the pelvis, July 21, 1954, showing numerous lytic lesions in the left ilium, each ischium, and the upper third of the left femur. The subtrochanteric lesion in the right femur has progressed slightly since the examination on May 4, 1954 (Fig. 1). Numerous lesions seen in the right ilium on the original film are not clearly reproduced.

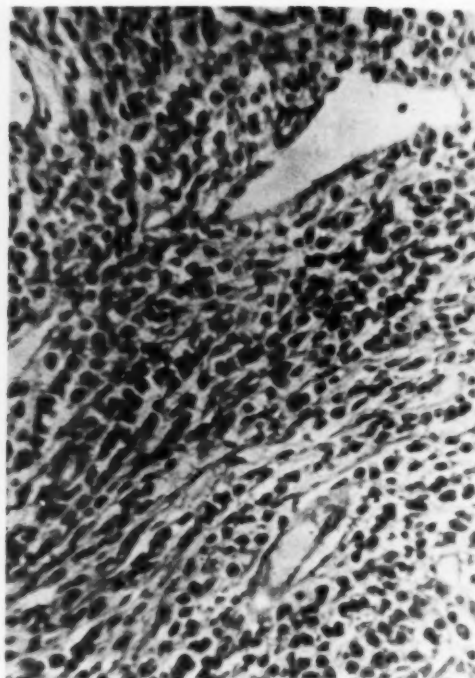


Fig. 5. Photomicrograph of a lytic skull lesion. The majority of the cells here were identified by the pathologist as myelocytes. Only a rare plasma cell and an occasional megakaryocyte could be found.

ingly few. There was no evidence of primary or metastatic carcinoma. Microscopic metastatic calcification was found in the lungs and kidneys. The bone lesions in the skull were the most interesting and informative. In the preparation of these specimens for decalcification, the inner and outer tables of bone separated, leaving a central core of whitish tumor-like tissue which could be easily sectioned without decalcification. This showed a loose type of fibrous tissue replacing all bone trabeculae. Throughout the meshes of this fibrous tissue were scattered cells resembling atypical myelocytes. There were rare megakaryocytes but rather numerous nucleated red blood cells. The pathologist believed the marrow lesions to be very similar to those described by Craver and Copeland (1) in 1935. His conclusion was that this was a case of atypical myelogenous leukemia.

Dr. Henry Rappaport, pathologist at Mount Sinai Hospital, Chicago, Ill., reviewed the slides and is in entire agreement with this conclusion. He commented that there is actually no fundamental difference between granulocytic leukemia involving the bone marrow diffusely and that rare form in which skeletal and extraskeletal tumors appear. The terms myelosarcoma and granulocytic leukosarcoma are sometimes applied to this latter variant of the disease.

SUMMARY

A case of chronic myelogenous leukemia in an adult with extensive bone lesions

demonstrated roentgenographically and at autopsy is presented. A review of the English literature disclosed only 7 such cases. The lesions were strikingly similar to the destructive bone lesions observed in multiple myeloma or in metastatic carcinoma.

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SUMARIO

Leucemia Mielógena Crónica: Extrañas Alteraciones Oseas en un Adulto

Raramente se descubren lesiones óseas destructoras en sujetos adultos que padecen de leucemia mielógena crónica. En la literatura en inglés no pudieron encontrarse más de 7 de esos casos. Comuníquese un

caso mantenido en observación tres años y confirmado en la autopsia. Las lesiones osteolíticas muy similares a las del mieloma múltiple o a metástasis carcinomatosas están diseminadas.



Use of Roentgen Rays to Establish the Identity of Interchanged Infants¹

STANLEY H. MACHT, M.D.

IN RECENT YEARS there have been occasional reports of "mix-ups" of newborn infants in busy hospital nurseries. Many hospitals routinely obtain footprints at birth as protection against such occurrences. Some hospitals, however, do not use the footprint system. In such insti-

almost impossible for the average hospital laboratory. Under such circumstances the identity of the two infants was recently established roentgenographically to the satisfaction of the parents. This was possible because one of the infants had chest roentgenograms made at the time of birth,

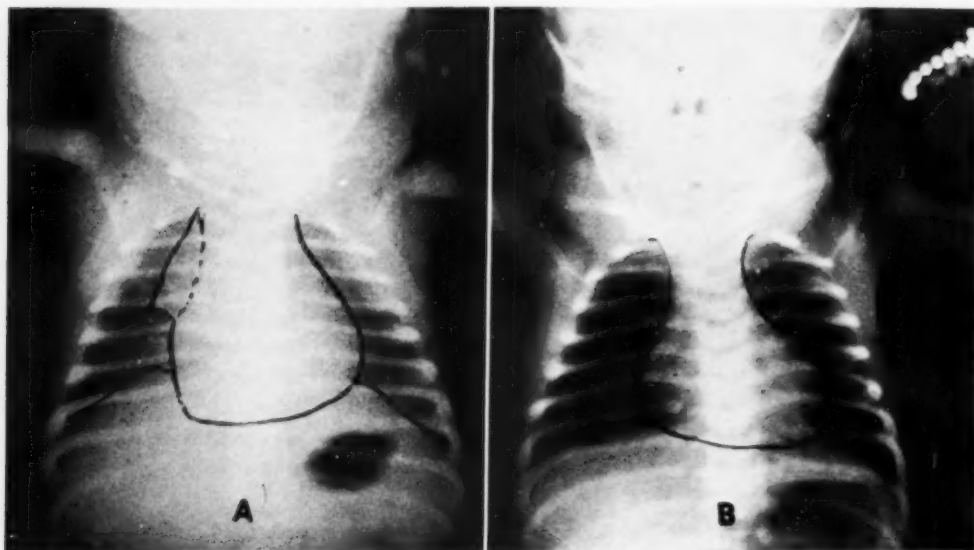


Fig. 1. Retouched roentgenograms showing the large thymus shadow in Baby Girl D. No. 1 (A) and the absence of a thymus shadow in Baby Girl D. No. 2 (B).

tutions if a possible interchange has occurred, identity may be determined by a study of the blood types of the parents and infants. If the blood groups of the two sets of parents are different, identity can be established with accuracy. If, however, the two mothers happen to be of the same blood type (*e.g.*, Type A), and if the fathers are also of identical type (*e.g.*, Type O), and if all are Rh positive, identification of the children becomes

which was prior to the birth of the second infant with whom she subsequently was interchanged in the nursery.

Since the author has been unable to find any reference to the use of x-ray studies for this particular purpose,² it is felt that the following case is worthy of being reported.

On April 6, 1955, Baby Girl D. No. 1, daughter of Kathryn D., was brought to the hospital nursery from the delivery

¹ Accepted for publication in November 1955.

² X-ray studies have been frequently used to identify bodies found in police work or in disasters. See Singleton, A. C.: Roentgenological Identification of Victims of the "Noronic" Disaster. *Am. J. Roentgenol.* **66**: 375-384, September 1951.

room. The infant was cyanotic and was taken to the x-ray department for chest roentgenograms. Standard postero-anterior and lateral films were made (Fig. 1A). These showed a prominent right lobe of the thymus but no other abnormalities. Five ossification centers for the sternum were noted on the lateral film (Fig. 2A).

On April 11, 1955, Baby Girl D. No. 2, daughter of Beatrice D., was admitted to the hospital nursery.

Early on the morning of April 12, Kathryn, the mother of Baby D. No. 1,

administrator, and the superintendent of nurses thereupon went to the home of Kathryn D. and informed her of the error. Her immediate reaction was that the baby she had brought home was her own, and that the visitors for some unknown reason wanted to take it away from her. She was finally prevailed upon, however, to return the child to the hospital for laboratory studies to prove its identity.

There it was found that both mothers had Type O blood, and both fathers Type A. All were Rh positive. During

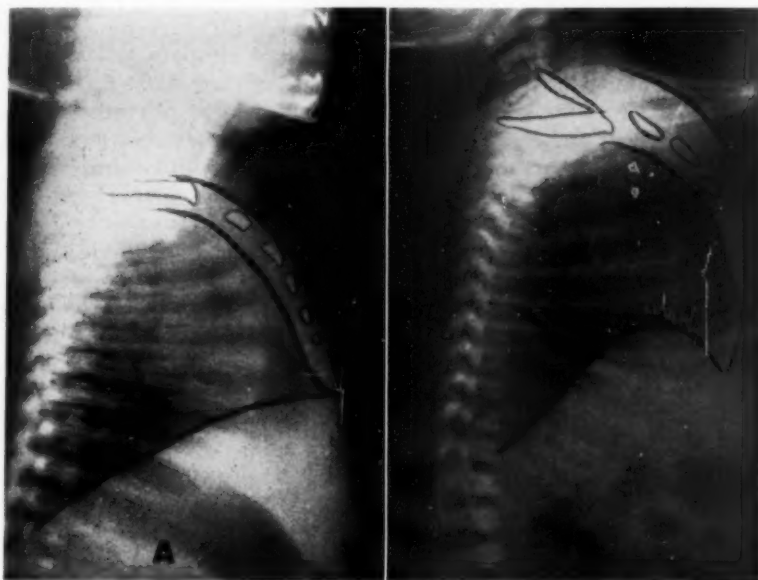


Fig. 2. Retouched roentgenograms showing five ossification centers in the sternum of Baby Girl D. No. 1 (A) and only three in Baby Girl D. No. 2 (B).

was discharged from the hospital, while the daytime supervisor of the nursery was off duty. A second nurse, not knowing there were two baby "Ds," took the first Baby D. she saw, which was Baby D. No. 2, and sent it home with Kathryn, who did not recognize it as being different from her own child, which she had seen only fleetingly during her hospital stay since it was not breast fed.

The supervisor of the nursery, on her return, recognized the situation and advised the hospital administrative authorities. The patient's physician, the hospital

the dilemma the radiologist learned of the distressing situation and, knowing that chest films had been taken of Baby D. No. 1, suggested x-ray studies of the chests of both infants to obtain a graphic method of convincing the parents of the identity of the children. Standard postero-anterior and lateral films were made. One infant again showed the large thymus and 5 ossification centers in the sternum. The second showed only 3 ossification centers in the sternum and the thymus was not visualized (see Figs. 1 and 2). When all of the films were shown to both sets of

parents, they were thoroughly satisfied as to the correct identity of the children and all returned home mentally and emotionally at ease.

SUMMARY

A case of interchange of two infants of the same name, occurring in a hospital nursery, is reported. Identification was established by means of roentgenograms of

the chest, which were compared with a film obtained shortly after birth of one of the children. This had shown an enlarged thymus and five ossification centers in the sternum. These findings were again demonstrated, while the thymus was not visualized in the second child and the ossification centers numbered only three.

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SUMARIO

Uso de los Rayos X para Establecer la Identidad de los Lactantes Intercambiados

En casos de intercambio fortuito de criaturas en la maternidad de un hospital, puede ordinariamente establecerse la identidad (a falta de podogramas) por la determinación de los tipos sanguíneos de ambos grupos de padres y de hijos. Descríbese un caso en que esto resultó imposible, dado que ambas madres y ambos padres revelaron los mismos tipos sanguíneos y todos eran Rh-positivos.

Las radiografías tomadas a uno de los

niños poco después del nacimiento, con motivo de cianosis, habían mostrado un timo agrandado y cinco centros de osificación en el esternón. Después del intercambio, se obtuvieron radiografías de ambos pequeños y sobre esa base se estableció la identidad. Uno reveló de nuevo hipertrofia del timo y cinco centros esternales de osificación; en el otro no podía distinguirse el timo y sólo aparecían tres centros de osificación.



Aeration of the Respiratory and Gastrointestinal Tracts During the First Minute of Neonatal Life¹

ANTHONY G. BOREADIS, M.D., and J. GERSHON-COHEN, M.D.

THE PRESENCE and significance of gas in the gastrointestinal tract during the first hours of life have been discussed by several writers (1-4), but none of these has dealt with observations during the first minute of neonatal life. In the study to be reported here, roentgenographic observations were made on 25 infants to ascertain whether pulmonary and gastrointestinal aeration occur simultaneously immediately after birth.

METHOD

Anteroposterior roentgenograms were taken with a portable x-ray unit installed near the delivery table. All films were taken between twenty-five and sixty seconds after birth. Another roentgenogram was taken in the same position twenty-four hours later. In a few instances, further films were obtained after three, four, and five days, for a study of delayed lung expansion. All infants were normal and were born at full term. General anesthesia, usually a combination of nitrous oxide, oxygen, ether, and Trilene, was used at the time of delivery. No complications occurred during the deliveries, and in no instance was artificial resuscitation practiced.

RESULTS

In only 13 of the 25 infants examined was gas observed in the stomach within sixty seconds after birth (Table I). Incomplete pulmonary aeration was present, in varying degree, in all of this group of 13. Of the 12 infants with no air in the stomach, 8 had good and 4 only fair pulmonary aeration. As judged from these observations, aeration of the respiratory and gastrointestinal tracts does not occur simultaneously. In none of the infants was gas seen in the small intestine or colon during the first minute of life.

TABLE I: ROENTGENOGRAPHIC OBSERVATIONS OF AIR IN LUNGS AND STOMACH

Pulmonary Aeration		Gas in Stomach	
Immediately after birth			
Good	6	Yes	13
Fair	5	No	12
Poor	14		
Twenty-Four hours after birth			
Good	21	Gas in stomach, small intestine and colon in all cases.	
Fair	4		

DISCUSSION

Our findings do not support the suggestion of Frimann-Dahl, Lind, and Wegelius (1) that as soon as the child is born, air is drawn into the esophagus, stomach, and lungs simultaneously. Breslau's test is used in forensic medicine for showing whether or not a child has been born alive. This test is done simply by determining whether the stomach or intestines float in water. According to our findings, results of such a test might be misleading if applied to infants dying within the first minute after birth.

Dillon (2) believed that gas in the stomach was proof of life and that it might be present even if no air was detectable in the lungs. Wasch and Marck (3) also assumed that gas was present in the stomach immediately after birth, but their studies did not begin until one-half hour after delivery. We never found air in the stomach without air in the lungs, but it is conceivable that in tracheal or bronchial obstruction, atelectasis, pulmonary hypoplasia or aplasia, air might be swallowed in the struggle for existence during the first few minutes of life.

Frimann-Dahl, Lind, and Wegelius thoroughly portrayed the distribution of gas in the stomach and intestines during the first three hours of life and at the end of twenty-four hours. They showed that

¹ From the Albert Einstein Medical Center, Northern Division, Philadelphia, Penna. Accepted for publication in August 1955.

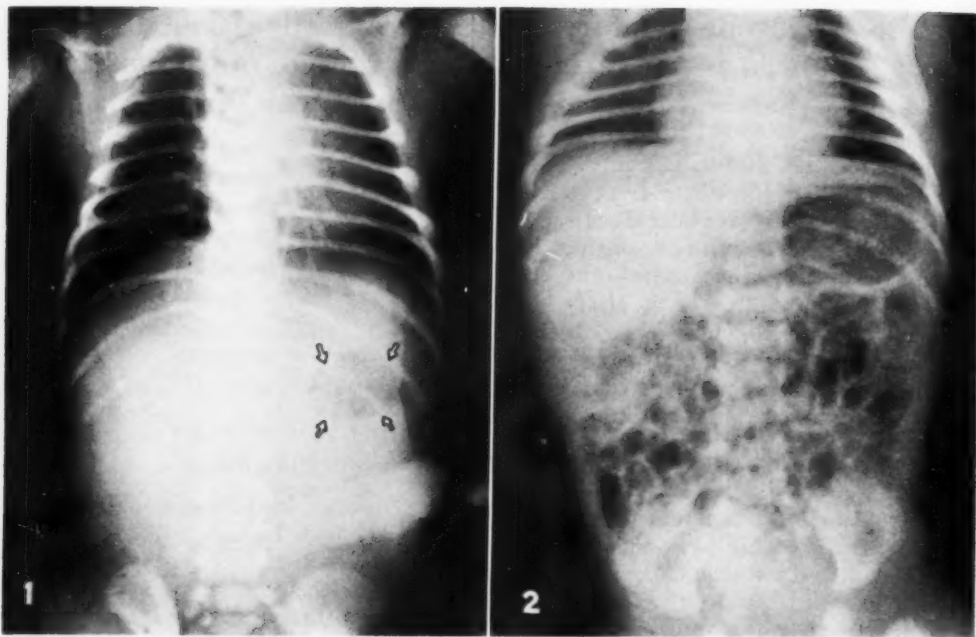


Fig. 1. Gas in the stomach and incomplete aeration of the left upper lung fifty-five seconds after birth.
 Fig. 2. Same infant after twenty-four hours. The lungs are well aerated and gas is distributed in the stomach and intestines.

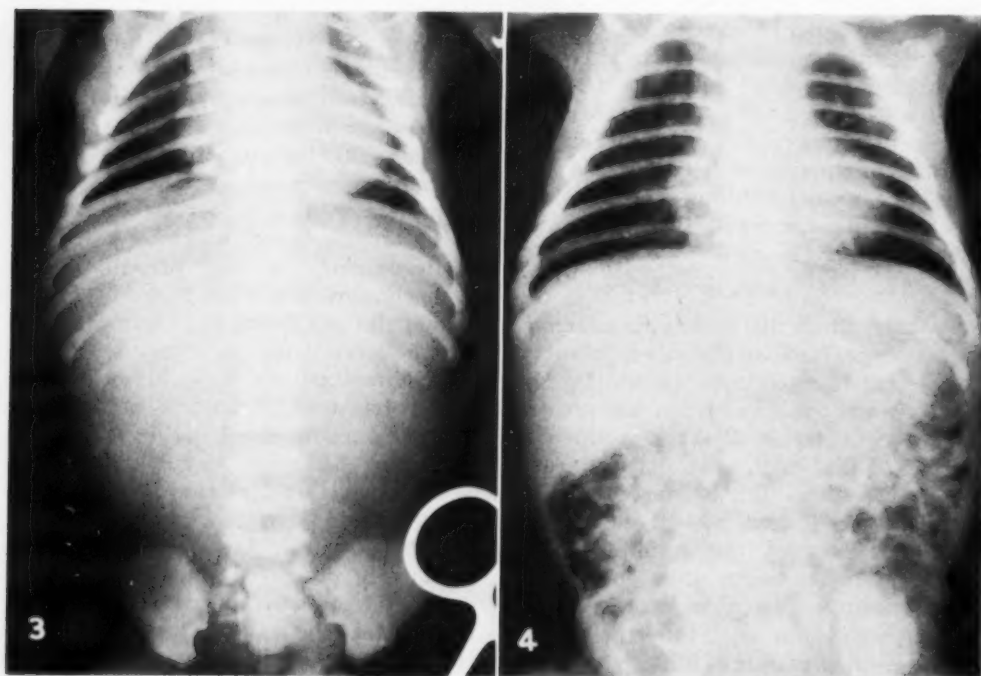


Fig. 3. No gas in stomach fifty seconds after birth, but both lungs well aerated.
 Fig. 4. Same infant, twenty-four hours later. Gas is widely distributed in the gastrointestinal tract.

after the first minute of life, air was found in the lungs and stomach, that at fifteen minutes air reached the jejunum, at forty-five minutes the ileum, and at two hours the cecum. These findings were in agreement with Breslau tests which they did in 15 more infants. We found, as they did, that gas was present in the entire gastrointestinal tract at the end of twenty-four hours (Figs. 2 and 4). Podolsky and Jester (4), from their studies of 35 newborn infants, concluded that the type of anesthesia, duration of labor, sex, or color had no appreciable bearing on the distribution of gas in the intestinal tract during the first twelve hours. Nothing in our findings would alter these impressions.

SUMMARY

A roentgenographic study of the respiratory and alimentary tracts of 25 infants was performed between twenty-five and sixty seconds after birth. Pulmonary aeration was present in varying degree in all infants, but in only 13 was gas present in the stomach at this time. It is concluded,

therefore, that aeration of the lungs normally precedes entrance of air into the stomach. No air was noted in the small or large intestine during the first minute of life.

NOTE: Our grateful acknowledgments for their helpful cooperation are extended to the members of our Obstetrical and Gynecological Staff, and to Miss Shirley Yaffe for her efficient technical assistance.

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SUMARIO

Aireación de los Aparatos Respiratorio y Gastrointestinal Durante el Primer Minuto de la Vida

Este estudio radiográfico comprendió los aparatos respiratorio y alimenticio de 25 lactantes entre veinticinco y sesenta segundos después del nacimiento. En todas las criaturas había más o menos aireación pulmonar, pero solamente en 13 había gas

en el estómago en aquel momento. Por lo tanto, dedúcese que la aireación de los pulmones precede normalmente la entrada de aire en el estómago. No se notó aire en el intestino delgado o grueso durante el primer minuto de la vida.



Roentgen Demonstration of Gas in the Fetal Circulatory System, a Valuable Sign of Fetal Death¹

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THE X-RAY demonstration of gas in the circulatory system of the fetus is a pathognomonic sign of fetal death. First described in 1944 (1), it appears, nevertheless, not to be well known, a search of the literature having disclosed less than 30 reported cases. Were it more widely known, it is probable that it would be found with greater frequency. Thus Crick and Sims, working at Auckland Hospital (New Zealand), were able to find 7 cases exhibiting this sign in a period of seven months (2). They believe that it occurs earlier than Spalding's sign (overlapping of the bones of the fetal skull). The fact that Spalding's sign and other roentgen indications suggesting fetal death are not infrequently misleading (3-5) emphasizes the importance of the observation of gas in the fetal circulatory system. The origin of the gas has not yet been determined.

CASE REPORT

Mrs. B. W., a 24-year-old white woman, was first seen Nov. 4, 1954, in her second pregnancy. The date of onset of her last menstrual period was July 30, 1954, and the estimated date of conception was May 7. Her previous pregnancy had been uneventful and had resulted in the delivery of a normal infant at term, Dec. 27, 1952. There was no history of any significant disease, and the general health had been excellent. Physical examination revealed no systemic disease. Blood pressure was 120/80. The weight was 138 1/2 lb. compared to a usual weight of 131 lb. Laboratory data included: hemoglobin 12 gm.; positive Rh factor; blood type A; negative Wassermann reaction. Urinalysis was normal.

The course of the pregnancy appeared normal, with average weight gain and consistently normal blood pressure determinations and urinalyses. Quickening was first noted by the patient on Nov. 30. At an examination on March 25, 1955, fetal parts could be felt and fetal heart sounds were heard in the right lower quadrant. On April 15, the patient reported that no fetal movements had



Fig. 1. Lateral roentgenogram showing gas in the fetal heart, aorta, and umbilical vessels.

been felt for two days. Examination disclosed a loss of uterine and fetal tone and absence of fetal heart sounds. An x-ray examination revealed a single, term fetus with vertex presenting, L.O.A. Gas was visualized roentgenographically in the fetal circulatory system, in the heart and in the abdominal and umbilical vessels, being best seen in the lateral projection (Fig. 1). There was no significant overlapping of the bones of the fetal skull, nor any unusual angulation of the spine.

X-ray studies were repeated on April 18, at which time the gas in the circulatory system was less sharply outlined. Slight overlapping of the bones of the fetal skull was present and repeated exposures showed no fetal movement. The conclusion, was that these roentgen signs indicated fetal death.

On April 27, 1955, spontaneous labor occurred and a macerated female fetus was delivered. No autopsy was done because of the advanced decomposition of the fetus. The postpartum course was uneventful and the patient was discharged from the hospital April 29, 1955.

SUMMARY

The roentgen demonstration of gas in

¹ Accepted for publication in October 1955.

the fetal circulatory system is a pathognomonic, and perhaps the earliest, x-ray sign of fetal death. A case is reported which illustrates these points.

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SUMARIO

El Descubrimiento Roentgenológico de Gas en el Aparato Circulatorio Fetal, Signo Valioso de Muerte del Feto

El descubrimiento radiológico de gas en el aparato circulatorio del feto es un signo roentgenológico diacrítico, y quizás el más temprano, de muerte fetal. Pre-séntase un caso que ilustra estos puntos.

En el mismo había gas observable en el corazón, aorta y vasos umbilicales del feto, en tanto que todavía no existía mayor sobreposición de los huesos del cráneo fetal (signo de Spalding).



Scurvy Following Folic Acid Antagonist Therapy¹

JOHN M. DENNIS, M.D., and RAUL MERCADO, M.D.²

ALTHOUGH FOLIC acid antagonists have been widely used in recent years, there have been only a few reports of their effects on Vitamin C metabolism. Recently, we have seen a patient with widespread neuroblastoma in whom typical scorbutic changes developed in the long bones during the course of aminopterin therapy.

CASE REPORT

B. P., a 16-month-old white girl, was admitted to the University Hospital on Dec. 16, 1952, with progressive bilateral exophthalmos, more marked on the left; edema, venous engorgement and capillary dilatation of the upper eyelids; hepatomegaly; and otitis media of the right ear. Admission roentgen studies revealed multiple osteolytic lesions (Fig. 1) considered to be those of a metastatic neuroblastoma, in the skull, pelvis, and long bones. The latter diagnosis was confirmed by bone-marrow studies and a biopsy of the right tibia.

The otitis media was treated with penicillin, streptomycin, and hydrogen peroxide irrigations. Beginning on Jan. 14, 1953, cortisone was given in doses of 50 mg. every eight hours until Feb. 4, after which the amount was decreased by 50 per cent every two days until discontinuance of the drug on Feb. 14. On Feb. 9, in conjunction with the cortisone, the patient was started on 0.5 mg. of aminopterin daily. This dosage was increased to 1 mg. daily on Feb. 18, but was again reduced to 0.5 mg. daily on Feb. 26. Clinically, the patient improved and on March 1 was discharged from the University Hospital, to be followed in the Out-Patient Department.

Following her discharge, the child was given not only 0.5 mg. of aminopterin daily, but also 100 mg. of ascorbic acid. Her general physical condition continued to improve, with increase in appetite, recession of the hepatomegaly, decrease in exophthalmos, and increased activity. Radiographically, the metastatic lesions in the skull and long bones diminished in number and showed evidence of recalcification. On April 21, 1953, however, roentgen studies of the long bones revealed the development of a ground-glass appearance and beginning fragmentation in the epiphyseal plates (Fig. 2). A diagnosis of scurvy was made but the therapeutic regime was not altered.

On three occasions during May and June 1953,



Fig. 1. Roentgenograms obtained prior to the institution of aminopterin therapy, revealing a poorly defined osteolytic metastatic lesion in the distal tibia but no evidence of a nutritional deficiency.

the patient had oral ulcers, which promptly responded to the discontinuance of aminopterin for three or four days. On June 11, roentgen studies of the long bones revealed more pronounced scorbutic changes, with an increased ground-glass appearance and fragmentation of the epiphyseal plates, transverse bands of diminished density in the metaphyses, and demineralization, with "halo effect," of the epiphyses (Fig. 3). The aminopterin therapy was continued and the ascorbic acid was increased from 100 to 500 mg. daily.

From June 11 to July 14, following the increase in ascorbic acid intake to 500 mg. daily, the scorbutic changes in the long bones showed moderate improvement radiographically (Fig. 4). There were improved calcification and decreased fragmentation of the epiphyseal plates and narrowing of the transverse line of demineralization in the metaphyses.

¹ From the Department of Radiology, University of Maryland School of Medicine, University Hospital, Baltimore, Md. Accepted for publication in October 1955.

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Fig. 2. Early scorbutic changes two and one-half months after institution of aminopterin therapy.

Fig. 3. More pronounced scorbutic changes, four months after the beginning of aminopterin therapy, even though the patient was receiving 100 mg. of ascorbic acid daily.

Fig. 4. Moderate improvement in scorbutic changes one month after the ascorbic acid intake was increased to 500 mg. daily, with the daily intake of aminopterin unchanged.

Fig. 5. Continued improvement four months later.

Even though the scorbutic changes were showing some improvement, the aminopterin was discontinued on July 14, 1953.

At this time, it was felt clinically that the metastatic lesions were progressing, as the patient now had hepatosplenomegaly, and she was re-admitted to the University Hospital on July 19, for re-evaluation. Radiographically, an improvement was noted in the metastatic lesions, though the scorbutic changes were still present in the long bones. Bone marrow studies from the left tibia failed to reveal malignant cells such as were found on the first admission. On July 21, in conjunction with her daily intake of 500 mg. of ascorbic acid, the patient was started on 150 mg. of cortisone and 0.5 mg. of potassium chloride, three times daily. She was discharged on Aug. 2, 1953, to follow the same therapeutic regime, with a salt-restricted diet and an additional 250 mg. of ascorbic acid daily. The cortisone was to be decreased 25 mg. daily following discharge.

Following the second University Hospital admission, the patient apparently was not kept on a salt-free diet while on cortisone, and on Aug. 5 she was admitted to the Washington County Hospital with marked edema. The cortisone was discontinued, and on Aug. 11 aminopterin therapy was again begun, with a daily dose of 0.5 mg. for approximately one month. After release from the Washington County Hospital the patient did quite poorly, with a gradual downhill course. On Sept. 28, she was admitted to the University Hospital for the third time, with severe edema, progression of the metastatic lesions, and a large palpable abdominal mass which, radiographically, contained calcifications. On Oct. 9, 1953, the mass was removed from the right suprarenal area and proved pathologically to be a primary neuroblastoma. Roentgen studies on Oct. 16 and Nov. 19, 1953 (Fig. 5) revealed demineralization in the metaphyses and epiphyses of the long bones and lines of temporary cessation of bony growth in the metaphyses. However, the localized transverse lines of demineralization and fragmentation of the epiphyseal plates were no longer noted. During this admission the patient was on variable doses of cortisone but received no aminopterin.

Roentgen therapy was given to the metastatic lesions in the right tibia and skull, but the course continued downhill, with death on Dec. 27.

DISCUSSION

This case points out a possible relationship between folic acid antagonists and the utilization of vitamin C, with the production of scurvy. Reviewing the literature, we were unable to find any description of definite scorbutic changes following aminopterin therapy. However, in the Caldwell

Lecture of 1952, Neuhauser (1) mentioned diminution of bone density and metaphyseal fractures following the use of aminopterin in children and concluded that they simulate scurvy.

In the case presented, we feel that the changes noted radiographically in the long bones are quite typical of scurvy (Figs. 2 and 3). Even though vitamin C blood levels were not obtained, the response of the osseous changes to massive doses of ascorbic acid further substantiates the diagnosis of the disease (Figs. 4 and 5).

The patient was given 100 mg. of ascorbic acid daily at the onset of the aminopterin therapy, to counteract any bleeding tendency due to the malignant process. Although this dose was several times greater than the minimal daily requirement, it was not sufficient to prevent the scorbutic changes. While moderate improvement in the bone changes was detected radiographically within a month after increasing the ascorbic acid intake to 500 mg. daily, more rapid healing occurred after discontinuing the aminopterin (Fig. 5).

When rats, which are able to synthesize vitamin C, are given aminopterin, a marked decrease in ascorbic acid content in the liver has been observed. This appears to be due to interference with biosynthesis of the vitamin within the liver. Other mechanisms which might account for this intrahepatic decrease of ascorbic acid, such as an increased excretion of vitamin C, increased rate of ascorbic acid catabolism within the liver, and translocation of vitamin C to other organs, were proved not to occur. Confirmatory evidence of this work was obtained in guinea-pigs, which cannot synthesize vitamin C, but which showed no decrease in the liver ascorbic acid content when fed vitamin C and aminopterin orally (2).

This experimental work is not directly applicable to man, who is unable to synthesize vitamin C and is dependent upon an adequate intake of the vitamin. Although we cannot offer a satisfactory explanation for the scorbutic changes

which occurred in the case reported above, it appears that the rather large amounts of vitamin C given at the beginning of the therapeutic regime were not properly utilized. However, after the ascorbic acid intake was increased to 500 mg., and then to 750 mg., daily, and the aminopterin discontinued, healing of the scorbutic changes progressed satisfactorily. This suggests that the most likely explanation for the development of these scorbutic changes is a disturbance of vitamin C utilization at the level of cellular metabolism. This may be another antagonistic manifestation of aminopterin and similar compounds.

SUMMARY

A case of widespread neuroblastoma is

reported in which typical scorbutic changes developed in the long bones during the course of aminopterin therapy. These changes responded favorably to massive doses of vitamin C and withdrawal of aminopterin.

The possible antagonistic action of aminopterin on vitamin C metabolism is discussed.

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SUMARIO

Escorbuto Consecutivo a Terapéutica Antagónica con Acido Fólico

Preséntase un caso de neuroblastoma generalizado en el que aparecieron típicas alteraciones escorbúticas en los huesos largos durante una serie de aminopterino-terapia. Estas alteraciones respondieron a dosis masivas de vitamina C y supresión

de la aminopterina. Parece que pueden ser consecuencia de obstrucción de la asimilación de la vitamina C al nivel del metabolismo celular. Puede tratarse de otra manifestación antagónica de la aminopterina y compuestos semejantes.



Aneurysm of the Sinus of Valsalva Associated with Coarctation¹

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THE PRESENCE of aortic sinus aneurysm has been reported in the recent literature with especial reference to the notable clinical events brought about by rupture of the aneurysm (1-3). Most often syphilis and bacterial endocarditis are the underlying causes. Aortic sinus aneurysm may occur, however, as a congenital anomaly. With the increasing use of angiocardigraphic studies in heart disease, the existence of such aneurysms, on both an acquired and congenital basis, has been demonstrated (1, 2, 4, 5).

In the case to be reported here, an aortic sinus aneurysm was associated with coarctation of the aorta.

CASE REPORT

J. T., a 21-year-old white female, had been examined repeatedly since the age of six, when following a febrile illness she was said to have heart murmurs, which were attributed to rheumatic fever. She had never suffered symptoms of cardiac decompensation, however, and was able to engage in all school athletic activities. During a recent routine examination, hypertension of 180/100 was noted in both upper extremities and an absence of pulses in the lower. So far as the patient knew, her blood pressure had been normal previously.

General physical examination was not remarkable except for the cardiovascular findings. The heart was enlarged to 2 cm. outside the mid-clavicular line in the sixth intercostal space. The first heart sound was forceful, and a prolonged rough systolic murmur was heard at the base, transmitted into the neck as well as interscapularly posteriorly. A softer systolic murmur was detected at the apex, with spread into the left axilla, and a faint early diastolic blow was heard over the base, with transmission down along the left sternal border. A systolic thrill was elicited over the aortic area, and the second aortic sound was markedly increased.

Blood count, urinalysis, and electrocardiogram were normal. A chest film (Fig. 1) and fluoroscopy revealed left ventricular enlargement and minimal evidence of notching of the posterior ribs. Angiocardigraphy (Fig. 2) demonstrated a coarctation of the aorta in the descending arch and an aneurysm

of the right aortic sinus measuring 4.4×5.0 cm. The coarctation was excised by Drs. Roy Cohn and George Armanini. No abnormality of the cardiac surface suggesting aneurysmal dilatation was seen.

The postoperative course was uneventful. Three months following surgery, blood pressure was 128/74 in the upper extremities, 110/70 in the right leg, and 130/90 in the left leg. The cardiac apex beat was now felt in the mid-clavicular line. The harsh systolic murmur at the base had diminished in intensity, as had the apical murmur. The second aortic sound was less forceful, and the early diastolic murmur was no longer audible. A chest film at this time showed slight decrease in heart size.

DISCUSSION

Jones and Langley (6) collected 47 cases of sinus aneurysm, of which 22 were acquired and 25 congenital. Associated with the congenital types were 2 cases of slight coarctation of the aorta. Recently, 5 cases were shown by angiocardigraphy to be associated with coarctation (4, 5).

It is believed that congenital sinus aneurysm arises from defective development of the bulbar septum which divides the primitive exit tube of the heart, the bulbus cordis, into right and left halves. This defective development is analyzed by Mall (7) as follows: When the aortic septum divides the bulbus cordis into the pulmonary artery and the aorta, the aorta shifts from the right side of the heart to occupy its posterior position, opening into the left ventricle. Simultaneously, the inferior septum at the base of the ventricles, which is destined to form the upper part of the ventricular septum, shifts from left to right. Eventually, the aortic septum fuses with the inferior septum. If the aorta fails to shift sufficiently, it overrides the right ventricle. If the aorta reaches its normal position but the fusion between the aortic septum and the ventricular septum is not complete, there results a high ventricular septal defect. Development may be complete, but a

¹ Accepted for publication in September 1955.

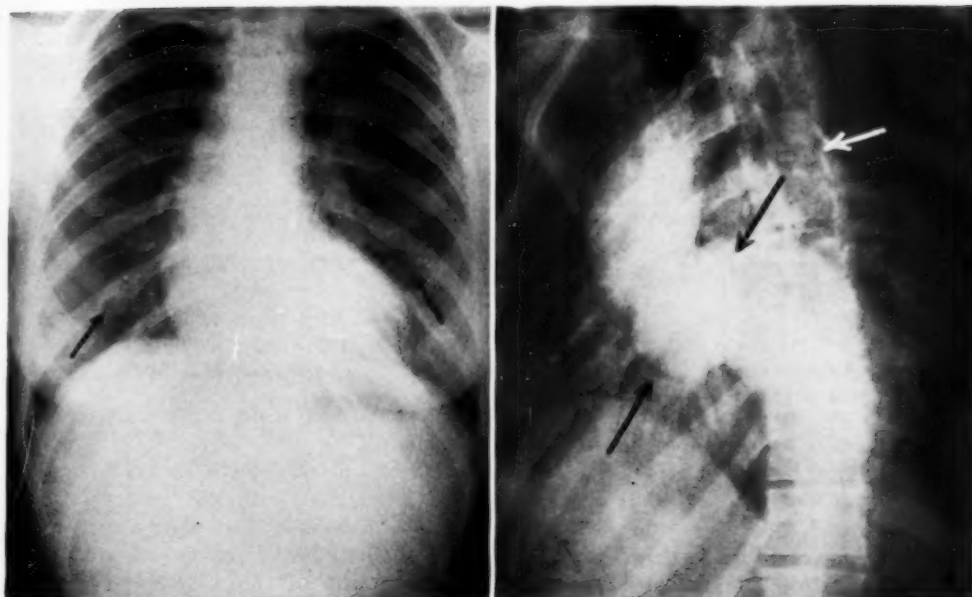


Fig. 1. Roentgenogram showing notching of ribs (indicated by arrows).

Fig. 2. Angiogram demonstrating aortic sinus aneurysm (black arrows) and coarctation of the aorta (white arrow).

weakness in the arterial wall may persist at the base of the right sinus of Valsalva. At this point, the wall may give way under the impact of the heart beat, with formation of an aneurysm.

Aneurysm prior to rupture is asymptomatic unless there are related incompetence of the aortic or tricuspid valves, other congenital defects, arachnodactyly, or endocarditis (6), with the resultant clinical, roentgenologic, and electrocardiographic features found with these conditions. With perforation into the adjacent cardiac chambers or pulmonary artery, there may follow severe pain and dyspnea, cardiac enlargement, widened pulse pressure, and a thrill and continuous murmur best heard in the 3rd or 4th left intercostal space close to the sternum. Heart failure usually progresses rapidly, and death soon follows.

Rupture of the aorta occurs in 23 per cent of cases of coarctation (8) and, since further dilatation of a concomitant sinus aneurysm will almost certainly result, surgical correction of the coarctation

is distinctly indicated. In one of the reported cases no change in the size of the Valsalva aneurysm was seen on angiocardigraphy following surgical excision of the coarctation (4). In our patient, post-operative disappearance of the diastolic murmur suggests increased integrity of the aortic valve and may perhaps indicate a decrease in aneurysmal size and pressure. It is reasonable to assume that reduction in pressure will reduce the risk of further enlargement and rupture of sinus aneurysms.

SUMMARY

A case of aortic sinus aneurysm associated with coarctation, demonstrated by angiocardigraphy, is presented.

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SUMARIO

Aneurisma del Seno de Valsalva Asociado con Coartación de la Aorta

Comunicase un caso de aneurisma del seno aórtico, o seno de Valsalva, asociado con coartación de la aorta. Se descubrió con la angiocardiografía, después de haber revelado un ordinario examen físico hipertensión de 180/100 en los miembros superiores y falta de pulsaciones en los inferiores. La coartación fué rectificada quirúrgicamente, con mejoría de la ten-

sión sanguínea y de otros signos cardiovasculares.

Dícese que sobreviene rotura de la aorta en 23 por ciento de los casos de coartación y, dado que casi seguramente ocurrirá mayor dilatación de un aneurisma concomitante del seno, la corrección quirúrgica de la coartación está claramente indicada.



X-Radiography with Beta-Emitting Isotopes¹

J. G. KEREIAKES, Ph.D., and A. T. KREBS, Ph.D.

THE IDEA OF USING isotopes in clinical radiography has been strongly advocated in recent years. As early as 1948 Spangenberg (1) published a radiograph of teeth, taken with cesium; Mayneord (2) demonstrated in 1950 the effectual use of thulium 170; and Dennis and DeLuca (3) reported the successful application of cerium 144 and thulium 170 in diagnostic radiology. The Argonne group (4) developed a portable isotopic x-ray source and Carpenter and his co-workers (5) recently described a complete portable isotopic x-ray unit, including isotope source and self-contained cassette, for field and emergency use.

In all cases so far reported, isotopes have been used which by themselves, and/or in connection with their decay products, emit beta, x-, and gamma radiation. Pure beta emitters have not as yet been studied systematically for their applicability in diagnostic radiography. With beta emitters the x-radiation is produced by the interaction of the beta rays with other material and is predominantly in the form of characteristic x-radiation and/or *bremsstrahlung*.

The present work was stimulated by that of Leboeuf and Stark (6) on the excitation of characteristic x-rays and the production of *bremsstrahlung* (internal as well as external) in proper target materials by beta radiation from strontium 90 and promethium 147. Strontium 90-yttrium 90 complex was the source for radiographically applicable x-radiation.

EXPERIMENTAL

The strontium-yttrium (Sr^{90} - Y^{90}) source available for the present studies was a Tracerlab RA-25 strontium medical applicator. It consists of the source with an active diameter of 5 mm. (overall diameter

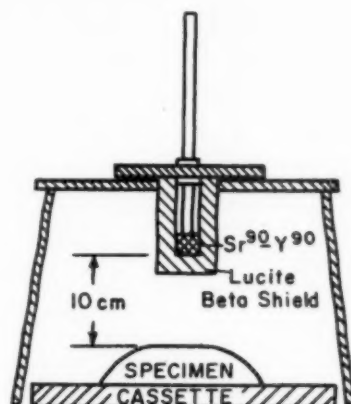


Fig. 1. Experimental arrangement.

12.7 mm.) mounted on the end of a 6 3/4-inch shaft. A circular plastic shield (4 in. in diameter, 3/8 in. thick) protects against irradiation during handling of the applicator. The source contains Sr^{90} in equilibrium with Y^{90} in such an amount that the surface dosage rate is 330 ± 10 per cent roentgen-equivalent betas per second, as measured with a Tracerlab extrapolation ionization chamber. The radiation emitted by the source consists of the 0.537-MEV beta rays resulting from the disintegration of Sr^{90} into Y^{90} and the 2.18 MEV beta rays produced in the decay of Y^{90} into stable zirconium. The average beta energies for Sr^{90} are 0.22 MEV and for Y^{90} are 0.7 MEV. The half life of the former is about twenty years, of the latter about sixty-two hours.

The source has a metallic protective cover (2 mils of stainless steel, 10 mils of aluminum) equivalent to about 100 mg./cm.² filtration and is double hermetically sealed. The covering reduces the number of beta particles resulting from the decay of Sr^{90} and the decay of Y^{90} to 3 per cent and 60 per cent of the original value,

¹ From the Radiobiology Department, Army Medical Research Laboratory, Fort Knox, Ky. Accepted for publication in September 1955.



Fig. 2. Radiograph of a rat obtained with x-radiation from a $\text{Sr}^{90}\text{-Y}^{90}$ source. Source-specimen distance 10 cm.; exposure time five minutes.

respectively. Lucite, 1.2 cm. thick, placed between the source and body to be radiographed, absorb the emitted beta radiation.

Due to the interaction of the beta rays with material, however, the source in its normal form also emits x-rays resulting primarily from *bremsstrahlung* and characteristic x-radiation produced in the source and absorber material. It is this x-radiation which was used essentially for the radiographic studies presented in this report. Figure 1 shows the details of the experimental arrangement.

RESULTS AND DISCUSSION

Figures 2 and 3 are radiographs of a rat body and of a hand taken with Patterson



Fig. 3. Radiograph of a hand obtained with x-radiation from a $\text{Sr}^{90}\text{-Y}^{90}$ source. Source-specimen distance 10.5 cm.; exposure time five minutes.

"Fluorazure" intensifying screens placed above and below the film (Eastman Kodak "Blue Brand"), with exposure times of five minutes and source-specimen distances of 10.0 and 10.5 cm., respectively.

The radiographic results show the existence of x-radiation emitted by the medical applicator in its common form. This radiation may be composed of: (a) internal *bremsstrahlung* arising from interaction of the nuclear beta particle with the radiation field of the nucleus, (b) external *bremsstrahlung* produced in the deceleration process of the beta particles by absorber nuclei, and (c) characteristic x-radiation produced by interaction of the beta particles with orbital electrons of the source material and/or of the capsule and absorber material. The internal *bremsstrahlung* is produced in the strontium-yttrium complex; the external *bremsstrahlung* in absorbing layers of the source and sur-

rounding material. Since only 3 per cent of the strontium beta radiations are transmitted by the protective cover (100 mg./cm.² filtration), it may be assumed that a certain part of the absorbed 97 per cent of these betas appears as x-radiation—characteristic radiation as well as *bremsstrahlung*.

According to Leboeuf and Stark (6) the yield for characteristic radiation provided by Sr⁹⁰-Y⁹⁰ betas in foils is 1×10^{-2} photons per incident beta particle, and the yield for higher energy *bremsstrahlung* is approximately 6×10^{-2} photons per incident beta. The internal *bremsstrahlung* of Sr⁹⁰-Y⁹⁰, extending from 10 kev to about 150 kev, shows a maximum at about 35 kev; the characteristic x-rays excited by Sr⁹⁰-Y⁹⁰ betas in tin have a maximum at 25 kev, followed by a *bremsstrahlung* peak at about 55 kev. The proper data for a steel-aluminum covered Sr⁹⁰-Y⁹⁰ source are not yet known. Preliminary measurements of the emitted radiation spectrum show that this radiation is heterogeneous, with some hard components.

The radiographs so far obtained with this simple and relatively weak isotopic x-ray source (300 mc source strength) show rather good definition and contrast, in spite of the large "focal spot" of the

source (5 mm. in diameter) and the relatively short source-specimen distance used in the exploratory studies. Better radiographs can be obtained by the use of smaller active diameter sources and with other beta-emitting isotopes and/or target materials emitting radiations properly fitted to the requirements of the body parts to be radiographed. The presented radiographs show definitely that pure beta emitters can be used for the production of radiographically applicable x-radiations.

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SUMARIO

La Radiografía X con Isótopos Emisores de Rayos Beta

Para la producción de radiografías se ha usado experimentalmente un foco de estroncio 90-itrío 90 (Sr⁹⁰-Y⁹⁰) con un recubrimiento protector de acero y aluminio. Además de la radiación beta producida por la desintegración del estroncio 90 en itrío 90 y la decadencia del itrío 90 a zirconio estable, también se emiten rayos X, debido a la interacción de los rayos beta con el

foco y el absorbente. Esta es la radiación X que se ha usado, esencialmente, para fines radiográficos.

Las radiografías obtenidas en esa forma muestran definición y contraste bastante buenos a pesar del tamaño del punto focal (5 mm. de diámetro) y la relativamente corta distancia foco-ejemplar empleada en los estudios experimentales.

WORK IN PROGRESS

The Utilization of Europium 152-154 in a Cervical Carcinoma Applicator

I. MESCHAN, M.D.,¹ T. H. ODDIE, D.Sc., F.Inst.P.,²
and MARSHALL BRUCER, M.D.³

In previous communications (1, 2), a specially designed tripartite applicator has been described for treatment of carcinoma of the cervix utilizing cobalt 60. The advantages of this applicator are: (a) ease of insertion; (b) fixed geometric relationships to facilitate calculation of gamma-ray dosage to the pelvis; (c) carefully evaluated relative intensities of various capsular sources to permit an optimum dose pattern in the pelvis; (d) selective relative diminution of radiation directed to the bladder and rectum. The chief disadvantage is the half-life of cobalt 60, namely 5.3 years, necessitating relatively frequent decay corrections and rather long treatment times after about two years. With this disadvantage in mind, the applicator has been modified to utilize europium 152-154, which has a half-life of 12.4 years (3).

Basic Physical Concepts: Unlike cobalt 60, which in its decay emits gamma rays of only two energies—1.17 and 1.33 MEV—europium 152 and 154, which are always admixed, emit a complex array of about eleven gamma-ray energies, ranging from 0.040 to 1.40 MEV, with an "average" emission not too dissimilar from that of cobalt 60, when relatively small amounts of filtration are applied.

Europium 152 and 154 are derived by neutron capture and gamma emission, from stable europium 151 and 153, the latter having high neutron capture cross sections. The sources utilized in the above applicator required irradiation for two weeks in a reactor at a flux density of about 10^{13} neutrons/cm.²/second. Very little europium 154 will be produced in such a short neutron irradiation.

The radioactive strengths of the sources were expressed as equivalent amounts of cobalt 60, by direct gamma-ray comparison at 1 meter with a Lauritzen electroscope. The actual strength of the source could not be predicted with greater accuracy than ± 15 per cent. It is not proportional to the mass of Eu_2O_3 in the capsule, due presumably to the shielding of the inner parts of a pellet and the high cross section for neutron absorption of the various isotopes and their daughters.

Source Design and Molding: Since europium for irradiation in the pile is available only as Eu_2O_3 powder, which has first to be pelleted and sealed her-

metically, the individual sources are pellets of Eu_2O_3 powder, admixed with aluminum. Aluminum pellets of appropriate size are used as inert separators, and all are enclosed in thin-walled aluminum capsules.⁴

Each source capsule, designed to have an active length of 1 cm. (Fig. 1), consisted of seven pellets of 2.38 mm. diameter and 1.43 mm. length, within a cylindrical aluminum can of 3.97 mm. overall diameter and 13.0 mm. length. After loading, the end of the aluminum cylinder was sealed by spinning. No heat was utilized in the molding of the pellets, which was performed in a specially constructed 12-cavity mold.

Only slight variations in design were made from the original tripartite cobalt 60 cervix applicator to accommodate the europium pellets and capsules. The major difference was the slightly thinner lead absorber centrally at either end of the colpostat capsule (reduced by 1.5 mm. at each end) to accommodate the 1.3 cm. aluminum container into which the europium pellets were loaded. The dosimetry patterns previously established for use with the cobalt 60 applicator can thus be readily applied.

The chief advantage of the above applicator in comparison with its cobalt 60 counterpart is the longer half-life of the europium 152-154; its uses are otherwise the same.

It is difficult at this time to compare relative costs because the high initial costs for europium and its molding, irradiation, and loading were on an experimental basis. It is reasonable to expect that such sources can be made and molded at less cost than cobalt 60.

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⁴ The materials used for molding the pellets are as follows:

Powdered Eu_2O_3 (99.8 per cent pure), lot 421, obtained from Research Chemicals Inc., 831 North Lake Street, Burbank, Calif.

Aluminum powder (-40 mesh), obtained from A. D. Mackay, Inc., 198 Broadway, New York 38, N. Y.

The molding and measurement of the europium 152-154 pellets were carried out at the Medical Division of the Oak Ridge Institute of Nuclear Studies.

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³ Oak Ridge Institute of Nuclear Studies, Medical Division. Under contract with the USAEC.

EDITORIAL

Call to the Annual Meeting Radiological Society of North America

The annual meeting of the Radiological Society of North America will be held this year at the Palmer House in Chicago, Dec. 2-7, 1956. As President of the Society, I take pleasure in inviting you, your families, and your friends to attend this meeting.

The program is planned with the idea of bringing to you the latest developments in our science with correlation of fundamentals as they apply to everyday radiological practice. To achieve this, a number of symposia and panels have been organized, with outstanding men as participants.

The arrangement of the meeting adheres to the usual plan, with three sections. Section A, Clinical Radiology, and Section B, Radiophysics and Radiobiology, meet on four mornings, Tuesday to Friday, inclusive. Sections A and B meet in combined afternoon sessions from Monday through Thursday. These sessions are planned to be of interest to both radiologists and radiophysicists. A third section—known as Section C—will meet on Wednesday afternoon and devote itself to discussion of the last-minute advances in radiophysics. Both Sections B and C are under the able direction of Lauriston S. Taylor.

Two features of the Monday morning General Session we hope will prove most interesting: The Historical Lecture and the Memorial Fund Lecture, the latter planned by the Memorial Fund Trustees to stimulate interest in the fund which was started many years ago to help young researchers in our specialty.

The Society is to be honored this year by one of its past presidents, Dr. Lowell S. Goin, who will deliver the annual Car-

man Lecture on Tuesday evening, December 3. On the same evening, the ceremony of bestowing the Gold Medal of the Society will be conducted, and announcement of the awards for Scientific Exhibits will be made.

An increased number of Refresher Courses have been arranged by the committee under the efficient chairmanship of Dr. Robert D. Moreton. Some repeat courses are to be offered, and there are to be many new ones. The announcement of these courses appears elsewhere in this issue of *RADIOLOGY*. Make your choices and your reservations early.

Business sessions of the Society, with membership attendance imperative, will be held promptly at 4:30 P.M. on Monday, Tuesday, and Thursday afternoons.

The Scientific Exhibits give promise of more than usual interest, with some new features being worked out by Chairman Dr. Ivan J. Miller. The manufacturers will again have the advantage of the large commercial exhibits display facilities of the Palmer House, with Dr. John H. Gilmore as chairman of the Committee.

Our good friends in Chicago, under the general chairmanship of Dr. Erich M. Uhlmann, are enthusiastically arranging for our pleasure and well being. The entertainment for the ladies, under the co-chairmen Mrs. Erich M. Uhlmann, Mrs. Warren W. Furey, and Mrs. John H. Gilmore, will be of the bountiful Chicago variety.

Your officers and committeemen join me in urging you to attend this Forty-second Annual Meeting of The Radiological Society of North America.

C. E. HUFFORD, M.D.
President

The Eighth International Congress of Radiology

The Eighth International Congress of Radiology, the first to be held in Latin America, met in Mexico City July 22-28, under the presidency of Dr. Manuel Madrazo. The new National Auditorium offered unexcelled facilities for the scientific sessions and exhibits, and the entire organization of the Congress down to the last detail was superbly handled. Grateful acknowledgment is due all who had a part in the planning of the meeting and the execution of the multitudinous details involved in such an undertaking. Dr. José Noriega, the Secretary-General, in particular is to be congratulated on the results of his efforts. They reflect credit not only upon his own country but upon all of Latin America. The total enrollment was 1,999, and 55 countries were represented.

An impressive Opening Ceremony featured an address of welcome by Dr. Madrazo, his investiture as President by Professor Flemming Møller, President of the Seventh Congress, and the "Ring in" of the Eighth Congress by His Excellency Dr. Ignacio Morones Prieto, Secretary of Public Health and Welfare for Mexico.

The Scientific Program included 367 papers devoted to a wide variety of subjects, but with the chief emphasis upon cancer therapy. While this was considered in all its aspects, particular attention was devoted to recent technical advances and the expanding use of radioactive isotopes.

Ninety-two scientific exhibits illustrated graphically nearly every phase of radiologic diagnosis and therapy and were highly instructive. A large commercial exhibit afforded an opportunity to evaluate the newest offerings of some 44 manufacturers of radiation equipment and accessories.

The International Executive Committee, meeting the week preceding the Congress, reached a number of important decisions, of which announcement was made.

1. The International Congress of Radiology will continue to be held every three years.

2. Spanish will be one of the official languages used in future Congresses of Radiology.

3. The next Congress of Radiology will be held in Germany, with Professor Boris Rajewsky as President. Present plans call for the meeting to be held in Munich.

4. The reports of the International Commission on Radiological Protection (I.C.R.P.) and the International Commission on Radiological Units (I.C.R.U.) were approved.

5. Professor Hans R. Schinz of Switzerland was appointed chairman of the International Commission for the Stage grouping of cancer, and presentation of results of cancer treatment (I.C.P.R.), succeeding the late Dr. Heyman.

6. A commission for the revision of the rules and regulations of the Congresses was formed, made up of Dr. Ross Golden, as chairman, and the secretaries-general of the three last Congresses, Dr. J. W. McLaren of Great Britain, Dr. Flemming Nørgaard of Denmark, and Dr. José Noriega of Mexico.

7. The report of the Organizing Committee of the new International Society of Radiology was approved. The new International Society becomes the functioning body in the interval between Congresses. Dr. Manuel F. Madrazo of Mexico is the President. Denmark is the seat of the permanent secretariat and treasury of the society, with Dr. Flemming Nørgaard as the Secretary-Treasurer. All funds collected in the name of the new society will be distributed equally among the various International Commissions.

The social aspects of the Congress not only added greatly to the pleasure of those attending but served to impress upon them the historical and cultural achievements of Mexico. Particular mention must be made of the performance of the pageant "The Sun's Messenger" following the official closing of the Congress. Over 1,200 persons participated in this spectacular presentation, which was dedicated to the members of the Eighth International Congress of Radiology.

There can be no question that the hope expressed by Dr. Noriega in his report as Secretary-General was amply fulfilled "that we have been able to convey to you an idea of what Mexico has been through its artistic, social and human achievements in the past, its intense efforts in the present, and its great and youthful faith in the future."

REFRESHER COURSES: POSTGRADUATE INSTRUCTION

The 1956 Refresher Course Series will be presented during the Forty-second Annual Meeting of the Radiological Society of North America at the Palmer House, Chicago, Ill. The courses will open at 2:30 P.M., Sunday, Dec. 2, and this opening session will be followed by a Film-Reading Session at 7:00 P.M. Commencing on Monday, Dec. 3, there will be ten courses daily from 8:30 to 10 A.M. through Wednesday. Because of the usual decrease in attendance the last two days, the number will be reduced to nine, from 8:30 to 10 A.M., on Thursday and Friday. No other meeting will be scheduled during the hours at which Refresher Courses are conducted. Attendance is limited to the medical profession, including graduate students and residents in radiology; radiation physicists, radiobiologists, chemists and others closely concerned with the science of radiology; and medical students certified by the deans of their respective medical schools.

A registration fee of \$15.00, which includes the Refresher Course fee, must be paid by all non-members of the Radiological Society of North America at the time of registration at the Palmer House. The exceptions are guest speakers, guest instructors, scientific exhibitors, residents or fellows in radiology, medical students, trainees in physics, and officers in the Armed Forces of the United States on temporary duty and away from their practice. Members of the Radiological Society of North America do not pay a registration fee or a Refresher

Course fee. All must register at the R.S.N.A. registration desk in the Palmer House. Admission to the Refresher Courses will be by presentation of the registration badge and a ticket for the particular course. Payment of the registration fee by non-members *is not* to accompany the request for tickets but is to be paid when the tickets are called for at the registration desk. If you cannot use the tickets you have reserved, please notify the Chairman of the Refresher Course Committee.

The Committee has tried to present new courses and put them in such sequence that those interested can attend various courses on the same system each day. Also, there is an increased emphasis on therapy, with an excellent course in this field every day. There are also daily courses on biophysics or isotopes. Many suggestions were made by members of the Society, and their interest and help are appreciated.

Read the description of the courses, noting particularly the days they are offered, and make your selection for each day. State your first, second, and third preferences. The number attending each course will be limited by the seating capacity of the room. You will be notified regarding your selections.

After you have gone over these courses we would appreciate suggestions for future courses, as well as new instructors for some of the present ones. Please put these on a card and leave it at the registration desk at the time you pick up your tickets.

Course No. 1: 2:30-4:30 P.M., Sunday

Fundamental Problems in Therapy

J. W. I. CARPENDER, M.D.
Moderator

CLIFFORD L. ASH, M.D., Toronto, Ont.
RALPH M. CAULK, M.D., Washington, D. C.
VINCENT P. COLLINS, M.D., Houston, Texas
MORTON M. KLIGERMAN, M.D., New York, N. Y.

Eight problems in radiation therapy will be discussed by the panel if time permits. Each panelist will submit two cases to the moderator, who will present them to the audience, withholding the result and the name of the panelist responsible. After discussion by one or all of the panel, the responsible person will be asked to give the result and defend the treatment used. Up to this point the panel and the audience will be in ignorance as to which panelist has actually treated the case, since he may be among those called upon to discuss the treatment.

Course No. 2: 7-9 P.M., Sunday

Film Interpretation Session

MERRILL C. SOSMAN, M.D., Boston, Mass.
Moderator

LAURENCE L. ROBBINS, M.D., Boston, Mass.
Co-Moderator

JOHN A. EVANS, M.D., New York, N. Y.
CESARE GIANTURCO, M.D., Urbana, Ill.
ARTHUR J. PRESENT, M.D., Tucson, Ariz.
DAVID M. GOULD, M.D., Little Rock, Ark.

This session is a diagnostic symposium based upon proved cases which will be demonstrated at the time of the course. The material presented will be supplemented by key films displayed at the afternoon session so that the audience will have a chance to see some of the original material.

Any member of the Radiological Society who desires to present a case which seems to merit display may submit the films, clinical summary, and pathological slides to the Co-Moderator, Laurence L. Robbins, M.D., Massachusetts General Hospital, Boston.

Course No. 3: 8:30-10 A.M., Monday

Medicolegal Problems

CHARLES L. EWING
General Claims Attorney
Atchison, Topeka and Santa Fe Railroad
Topeka, Kans.

This course will consist of an informal discussion

of the medicolegal problems confronting the radiologist; rights and duties of expert witnesses, including the right to demand fees before testifying; testimony both in court and by deposition.

Some suggestions regarding office records, clinical records, examination notes, written reports, and their impact on litigation will be offered.

Course No. 4: 8:30-10 A.M., Monday

Clinical Use of Radioactive Isotopes

DONALD S. CHILDS, Jr., M.D., and A. L. ORVIS, Ph.D.
Rochester, Minn.

The diagnostic and therapeutic applications of radioactive isotopes in medical practice will be discussed.

The physical and physiologic basis of certain diagnostic tests, technics of instrumentation, and interpretation of results will be considered. Tests of thyroid function and blood dyscrasia studies will be emphasized.

The therapeutic applications of radioactive isotopes to be included are I^{131} in hyperthyroid states, I^{131} in thyroid cancer, I^{131} to produce a hypothyroid state, P^{32} in polycythemia and leukemia, and radioactive colloids.

(This course continued Tuesday, Course No. 14)

Course No. 5: 8:30-10 A.M., Monday

Roentgen Therapy in Childhood

M. H. WITTENBORG, M.D.
Boston, Mass.

Radiotherapy problems, uniquely or predominantly found in childhood, will be presented and evaluated. Following a discussion of the tumor-host interaction in childhood, characteristic tumors of this age period will be reviewed individually, from the standpoint of both diagnostic and therapeutic approach. In each instance "our present state of knowledge" will be summarized quantitatively, with regard to the complications and prognosis.

Course No. 6: 8:30-10 A.M., Monday

Diagnosis of X-Ray Equipment Breakdowns and Radiation Output Changes

CARL B. BRAESTRUP
New York, N. Y.

Breakdown of x-ray equipment located outside metropolitan areas often causes prolonged interruption of operations; yet a few simple tests frequently serve to diagnose and correct the trouble.

Basic x-ray circuitry and common difficulties experienced with the various components will be demonstrated as an aid in trouble shooting by the radiologist. The relation between improper functioning of x-ray equipment and the radiation output will be considered, with special attention being given

to the types of replacement and repairs which are likely to produce significant increases in the dose rate.

Course No. 7: 8:30-10 A.M., Monday

Correlation of Functional States and Radiological Appearances of the Lung

AVERILL A. LIEBOW, M.D.
New Haven, Conn.

The influence of respiratory movements on the intrathoracic structures will be considered, with particular reference to the pumping of blood. Various mechanisms whereby blood may be shunted from one to another part of the lung will be discussed. Examples drawn from experimental and clinical material will be cited, demonstrating the circumstances under which functional changes are and are not reflected in the roentgenogram. The influence of certain congenital anomalies on circulatory phenomena in the thorax will be considered.

Course No. 8: 8:30-10 A.M., Monday

Genetic Effects of Radiation

B. F. KIMBALL
Oak Ridge, Tenn.

Damage to chromosomes, mutation or chromosomal aberration, is a basic part of the biological action of radiation. Chromosomal aberrations are probably an important cause of cell death and so may be indirectly responsible for many of the consequences of irradiation. Mutations and chromosomal aberrations in the germ cells have deleterious effects on the descendants of irradiated individuals and might, under some circumstances, be of considerable importance for the population as a whole. Some elementary principles of genetics and chromosome cytology essential to understanding and evaluation of these effects will be briefly reviewed. Recent experimental work on genetic and cytological effects of radiation on the germ cells of the mouse will be presented, with consideration of the implications of this and other work in evaluation of the genetic hazard. Finally, procedures that can be used to modify the amount of chromosomal damage will be discussed.

This course will provide a helpful background for the Symposium on Wednesday afternoon on the "Biological Effects of Radiation."

Course No. 9: 8:30-10 A.M., Monday

Radiographic Orthopedic Problems

CHARLES W. BREIMER, M.D.
New York, N. Y.

This course, to be given in two sessions, will consider problems in the x-ray diagnosis of bone and joint lesions encountered in patients in a hospital specializing in orthopedic and rheumatic diseases.

Conditions to be presented and discussed include atypical bone infections, avascular necrosis of the femoral head, unusual arthritides, cases of villonodular synovitis of various joints with bone invasion, aneurysmal bone cyst, and reticuloendothelial storage diseases. Also to be considered are the importance of soft-tissue roentgenograms of the knee, the importance of "stress" roentgenograms of the knee and the ankle following injury, technics for proper x-ray examination of the shoulder, the value of the "Hass" lateral projection of the hips in congenital dislocation, and various other orthopedic problems.

(This course continued Tuesday, Course No. 19.)

Course No. 10: 8:30-10 A.M., Monday

X-Raying the Stomach: Routine and Special Technics

ARTHUR FINKELSTEIN, M.D.
Philadelphia, Penna.

A preliminary discussion as to what should constitute a routine examination of the stomach and duodenum will be followed by a question-and-answer period for audience participation.

Next, certain special technics in the examination of the stomach will be considered: preliminary removal of non-opaque residue, including astringent lavage; use of respiratory movements in differentiating extrinsic pressure from intrinsic lesions; value of multiple exposures during swallowing; for detection of small or sliding hiatal hernias; over-distention technic for demonstration of regurgitation in the study of pyrosis; combined filling of stomach and colon in the evaluation of the splenic flexure syndrome; various methods of producing double-contrast visualization of the fundus; pharmacoradiology.

This will be a lantern-slide demonstration, and will terminate with a question-and-answer period.

Course No. 11: 8:30-10 A.M., Monday

Practical Problems in the Development and Use of Isodose Curves

E. DALE TROUT, D.Sc., and JOHN P. KELLEY, B.S.
Milwaukee, Wisc.

This course is designed for the radiologist who does not have extensive physics facilities available but who is interested both in the methods used to develop isodose charts and in procedures for adapting them to his particular situation. Much of the material presented is the result of several hundred requests for information on specific problems. Included will be information on back-scatter factors, adapting isodose curves for one half-value layer to another half-value layer for which curves are not available, and design of a plotting table.

The material will be presented with the aid of slides, and all information will be available in booklet form.

Course No. 12: 8:30-10 A.M., Monday

Roentgen Diagnosis of Renal Tumors and Cysts

JOHN H. WOODRUFF, Jr., M.D.
Los Angeles, Calif.

The radiologic diagnosis of renal cysts and tumors will be studied, with consideration of the various methods used in identification of such lesions. Particular attention will be directed toward the findings by preliminary films, urograms, pyelograms, renal angiograms, and percutaneous puncture of cysts. Nephrograms, body-section radiography, delayed urography, percutaneous puncture of the renal pelvis, and vena cavagrams will also be considered. Osseous, pulmonary, and gastrointestinal findings associated with these lesions will be discussed.

Course No. 13: 8:30-10 A.M., Tuesday

Basic Radiation Dosimetry

H. M. PARKER, M.Sc.
Richland, Wash.

1. Influence of spatial and temporal distribution of ionizing events in tissue.
2. Energy absorption in tissue as the basis for dosimetry.
3. Direct measurement of energy absorption—calorimetry.
4. Indirect measurement of energy absorption—the Bragg-Gray principle.
5. Relationship of the roentgen to this principle.
6. Extension of dosimetry to particulate radiation.
7. Use of the terms "rep," "rad," and "rem."

Any changes in terminology that may result from international meetings on units in 1956 will be included.

Course No. 14: 8:30-10 A.M., Tuesday

Clinical Use of Radioactive Isotopes

DONALD S. CHILDS, Jr., M.D., and A. L. ORVIS, Ph.D.
Rochester, Minn.

(Continued from Monday, Course No. 4.)

Course No. 15: 8:30-10 A.M., Tuesday

Examination of the Gastrointestinal Tract in Infants and Children

LAWRENCE A. DAVIS, M.D.
Louisville, Ky.

Examination of the gastrointestinal tract in infants and younger children is difficult only with respect to the technical problems involved. Actually, the range of abnormality is limited, and does not compare in complexity with that found in the adult. These technical problems, and how they can be easily solved by the radiologist and one technician, will be stressed. The various congenital and ac-

quired diseases found in pediatric practice will be analyzed, and the use of water-soluble contrast media discussed.

Course No. 16: 8:30-10 A.M., Tuesday
Problems and Errors in Neuroroentgenologic Diagnosis

COLIN B. HOLMAN, M.D.
Rochester, Minn.

Practical aspects of neuroroentgenology will be discussed with special reference to various problems and errors in diagnosis. The principles of interpretation will be briefly reviewed and a suggested procedure of film analysis will be discussed. Following this general orientation, the remainder of the presentation will be comprised of interesting examples illustrating the difficulties both in technic and in judgment which may be encountered, together with suggestions by which such situations may be improved.

Course No. 17: 8:30-10 A.M., Tuesday
Roentgen Recognition of Pulmonary Collapse
of (a) the Bronchopulmonary Segments;
(b) the Lobes; (c) an Entire Lung

GEORGE R. KRAUSE, M.D., and M. LUBERT, M.D.,
Cleveland, Ohio

The purpose of this course is to explain, by means of roentgenograms, diagrams, and models, the reasons for the roentgen appearance in collapse of a lung or subdivision thereof. The importance of the lateral view in the recognition of collapse will be stressed.

The presentation will include a roentgen demonstration of the anatomy of the sublobar bronchopulmonary segments, their identification, and appearance in disease. Bronchographic correlation will be used freely.

In the presentation of lobar collapse, the anatomic-spatial changes responsible for the roentgen appearance will be emphasized. It will be pointed out that when a lobe collapses it does not merely become a smaller replica of itself but undergoes a change in shape and position, characteristic for each lobe. The underlying unity of what seems to be a varied roentgen picture will be demonstrated.

A concept of the mechanism of collapse of an entire lung will be presented. This will be clarified by diagrams; a characteristic roentgen picture in the lateral view will be shown. This part of the course is to be the subject of an exhibit at the meeting.

Course No. 18: 8:30-10 A.M., Tuesday
Radium Therapy

JOHN REEVES, M.D.
Boston, Mass.

Following an informal review of clinical and phys-

ical fundamentals in surface, interstitial, and intracavitary radium therapy, a variety of illustrative cases will be presented in brief detail with discussion of treatment and sample calculations of radium dosimetry. Examples of the usefulness of tantalum-182 wire, gold-198 grains, and cobalt-60 sources in "radium-substitute" therapy will be included. The usefulness of radium and cobalt in "bomb" form will be considered.

The comparative advantages and disadvantages of 400-2,000 kv x-ray therapy will be discussed in some cases.

An attempt will be made to interrelate some of the radiotherapeutic philosophies of Great Britain, Scandinavia, and Texas with some of those in this country.

Among other data, a progressive set of clinical radium problems, each covering one of the Paterson-Parker rules, will be distributed, with one method of solution. Discussion will be welcomed.

Course No. 19: 8:30-10 A.M., Tuesday
Radiographic Orthopedic Problems

CHARLES W. BREIMER, M.D.
New York, N. Y.

(Continued from Monday, Course No. 9)

Course No. 20: 8:30-10 A.M., Tuesday
Duodenal Ulcer

ARTHUR FINKELSTEIN, M.D.
Philadelphia, Penna.

An informal review of the diagnostic criteria for duodenal ulcer. The importance of the crater, and methods of demonstrating it. Relative importance of fluoroscopy and radiography. Spot-filming and compression. Differentiation between a crater and barium caught between distorted folds. Evaluation of "secondary signs." Recognition of complications. Criteria of healing. Postbulbar ulcers and their differential diagnosis.

This course will be a lantern slide demonstration, and will terminate with a question-and-answer period.

Course No. 21: 8:30-10 A.M., Tuesday
Radiotherapy in Ophthalmology

GEORGE R. MERRIAM, Jr., M.D.
New York, N. Y.

The use of radiation in the treatment of ocular lesions will be discussed, with particular attention paid to the late effects. The clinical course of various diseases will be described briefly and the anticipated benefits of irradiation evaluated in terms of other therapeutic measures and the possible late sequelae. The discussion will be divided into three categories: superficial, low-voltage, and high-vol-

PLAN OF PRESEN

SUNDAY, Dec. 2 2:30-4:30 P.M.		MONDAY, Dec. 3 8:30-10 A.M.	TUESDAY, Dec. 4 8:30-10 A.M.
1. Fundamental Problems in Therapy J. W. J. Carpender, M.D., Moderator Clifford L. Ash, M.D. Ralph M. Caulk, M.D. Vincent P. Collins, M.D. Morton M. Kligerman, M.D.		3. Medicolegal Problems Charles L. Ewing	13. Basic Radiation Dosimetry H. M. Parker, M.Sc.
		4. Clinical Use of Radioactive Isotopes (continued Tuesday) Donald S. Childs, Jr., M.D. A. L. Orvis, Ph.D.	14. Clinical Use of Radioactive Isotopes (continued from Monday) Donald S. Childs, Jr., M.D. A. L. Orvis, Ph.D.
7-9 P.M.		5. Roentgen Therapy in Childhood M. H. Wittenborg, M.D.	15. Examination of the Gastrointestinal Tract in Infants and Children Lawrence A. Davis, M.D.
		6. Diagnosis of X-ray Equipment Breakdowns and Radiation Output Changes Carl B. Braestrup	16. Problems and Errors in Neuro-roentgenologic Diagnosis Colin B. Holman, M.D.
2. Film Interpretation Session Merrill C. Sosman, M.D., Moderator Laurence L. Robbins, M.D., Co-Moderator John A. Evans, M.D. Cesare Gianturco, M.D. Arthur J. Present, M.D. David M. Gould, M.D.		7. Correlation of Functional States and Radiological Appearances of the Lung Averill A. Liebow, M.D.	17. Roentgen Recognition of Pulmonary Collapse George R. Krause, M.D. Mortimer Lubert, M.D.
		8. Genetic Effects of Radiation B. F. Kimball	18. Radium Therapy John Reeves, M.D.
		9. Radiographic Orthopedic Problems (continued Tuesday) Charles W. Breimer, M.D.	19. Radiographic Orthopedic Problems (continued from Monday) Charles W. Breimer, M.D.
		10. X-Raying the Stomach: Routine and Special Technics Arthur Finkelstein, M.D.	20. Duodenal Ulcer Arthur Finkelstein, M.D.
		11. Practical Problems in Development and Use of Isodose Curves E. Dale Trout, D.Sc. John P. Kelley, B.S.	21. Radiotherapy in Ophthalmology George R. Merriam, Jr., M.D.
		12. Roentgen Diagnosis of Renal Tumors and Cysts John H. Woodruff, Jr., M.D.	22. Radiotherapy of Bronchogenic Carcinoma James E. Lofstrom, M.D.

PLAN OF PRESENTATION

	WEDNESDAY, Dec. 5 8:30-10 A.M.	THURSDAY, Dec. 6 8:30-10 A.M.	FRIDAY, Dec. 7 8:30-10 A.M.
23. The Physiopathology of Practice: Introduction to a Course on the Science and Art of Radiology L. Henry Garland, M.D.	33. Radiotherapy of Breast Cancer Vincent P. Collins, M.D.	42. Chemotherapeutic Agents Useful in Treatment of Malignant Disease Clyde O. Brindley, M.D.	
24. Rotation Therapy Robert Robbins, M.D., and Associate	34. Radiology of the Heart and Great Vessels (continued Friday) J. Stauffer Lehman, M.D.	43. Radiology of the Heart and Great Vessels (continued from Thursday) J. Stauffer Lehman, M.D.	
25. Pediatric Urological X-ray Diagnosis Raymond R. Lanier, M.D.	35. Fundamentals of Cerebral Angiography (continued Friday) Juan M. Taveras, M.D.	44. Fundamentals of Cerebral Angiography (continued from Thursday) Juan M. Taveras, M.D.	
26. Review of Pneumoencephalographic Diagnosis of Intracranial Masses Colin B. Holman, M.D.	36. Design and Equipment of Radioisotope Laboratories G. W. Morgan	45. Recovery from Radiation Injury Leon O. Jacobson, M.D.	
27. Mediastinal Masses Ted F. Leigh, M.D. H. Stephen Weens, M.D.	37. Some Fundamentals in Chest Roentgen Interpretation (continued Friday) Benjamin Felson, M.D.	46. Some Fundamentals in Chest Roentgen Interpretation (continued from Thursday) Benjamin Felson, M.D.	
28. Radium and Radioisotope Dosimetry Elizabeth F. Focht	38. The Statistical Point of View (continued Friday) Harold Tivey, M.D.	47. The Statistical Point of View (continued from Thursday) Harold Tivey, M.D.	
29. Principles of Roentgen Diagnosis in Primary Malignant Tumors of Bone Robert S. Sherman, M.D.	39. Diseases of the Joints Lester W. Paul, M.D.	48. Skeletal Manifestations of Developmental Disorders in Infants and Children John R. Hodgson, M.D.	
30. X-Ray Examination of the Small Intestine Lois Collins, M.D.	40. Examination of the Colon Charles W. Yates, M.D.	49. "Custom-Fitted" Radiation for Cervical Cancer Antolin Raventos, M.D. George Lewis, M.D.	
31. Cinefluorography George H. Ramsey, M.D. Frank L. Campeti, M.D. Raymond Gramiak, M.D.	41. Fundamental Considerations in Radiation Biology Titus Evans, Ph.D.	50. Aids, Gadgets, and Useful Tips for Beam and Dose Control Jeshill Love, M.D.	
32. Bodily Fate of Substances as a Basis for Roentgen Diagnosis Everett L. Pirkey, M.D. Peter K. Knoefel, M.D.			

tage therapy. The factors, dose, treatment time, and technic for each condition will be considered.

Under *superficial therapy*, both grenz rays and beta radiation will be considered, and the treatment of such conditions as vernal catarrh, corneal vascularization, precancerous melanosis, recurrent pterygia, nodular episcleritis, phlyctenular keratitis, bulbar and filamentary keratitis, and resistant corneal ulcers, will be covered.

The *low-voltage therapy* discussion will concern primarily the treatment of epithelization of the anterior chamber. A brief discussion of the relative values of radiation and surgery in the treatment of basal- and squamous-cell carcinomas of the lid will be presented.

Under *high-voltage therapy* such lesions as retinoblastoma, ocular lymphosarcoma, orbital hemangiomas, and metastatic carcinoma of the eye and orbit, will be covered.

Course No. 22: 8:30-10 A.M., Tuesday

Radiotherapy of Bronchogenic Carcinoma

JAMES E. LOFSTROM, M.D.
Detroit, Mich.

- I. Philosophical Approach
- II. Anatomical Considerations
 - A. Histologic
 - B. Clinical Stages
 - C. Morbid anatomy
 1. Primary site
 2. Routes of spread
 3. Metastatic disease
- III. Biophysical Aspects
 - A. Radiobiological
 1. Tumor tissue
 2. Normal tissue
 - B. Physical
 1. Dosimetry
 - a. Opposing portal
 - b. Multiple portal
 - c. Grid
 - d. Rotational
 - e. Time dose factors
- IV. Treatment Planning
 - A. 250 kvp
 - B. Cobalt 60 Teletherapy
 1. Fixed beam
 2. Rotational
- V. Adjuvant Therapy
 - A. Radioisotope
 - B. Chemotherapy
 - C. Endocrine
 - D. General
- VI. Follow-Up
- VII. Results
 - A. Primary disease
 - B. Metastatic disease
 - C. Evaluation of palliation
 1. Symptomatic

2. Extension of life
3. General support
4. Economic

D. Complications

1. Radiation changes
2. Infection
3. Necrosis
4. Obstruction

VIII. Summary: Established basic routine.

Course No. 23: 8:30-10 A.M., Wednesday

The Physiopathology of Practice: Introduction to a Course on the Science and Art of Radiology

L. HENRY GARLAND, M.D.
San Francisco, Calif.

"The oyster is a gentle thing, and will not come unless you sing." So reads an old maxim. The world is an oyster to a young radiologist. This course will attempt to outline certain aspects of various types of radiologic practice, hospital and office, governmental and private. Various forms of hospital-physician relationship will be analyzed, especially those under which the best type of radiologic service can be rendered to patients. In order to conserve time and permit discussion of newer trends, all participants will be assumed to have read and digested the official manual (*A Guide for Conduct of Radiologists in Relationships with Institutions*, American College of Radiology, 20 North Wacker Drive, Chicago, 1955). Questions already answered by that Guide will be regarded as tautologic. Specific questions submitted by registrants, in writing, will be answered during the course.

Course No. 24: 8:30-10 A.M., Wednesday

Rotation Therapy

ROBERT ROBBINS, M.D., and Associate
Philadelphia, Penna.

1. Terminology and types of rotation therapy; dose distributions for various types of rotation, and modification of dose patterns by partial rotation, weighting, shifting of axis or variation of body contour.
2. Comparison with conventional and supervoltage fixed portal therapy, with respect to dose pattern, convenience, reproducibility, set-up time.
3. Importance of localization and set-up technics, fluoroscopy, radiographic check, light beam pointers, transit dose, other devices.
4. Methods of dosimetry.
 - (a) Published results for specific examples.
 - (b) "Simulated beam" calculation.
 - (c) "Isodose curve" calculation.
 - (d) Transit-dose measurement.
 - (e) Computers.
 - (f) Measurements in phantom.

Course No. 25: 8:30-10 A.M., Wednesday**Pediatric Urological X-Ray Diagnosis**

RAYMOND R. LANIER, M.D.
Denver, Colo.

A brief discussion of technic for obtaining satisfactory excretory pyelograms, cystograms, and urethrograms in infants and small children will precede demonstration of normal variations and the more common congenital anomalies. These will be followed by cases illustrating the effects of trauma to the urinary tract. The more common infections and their sequelae will be presented, and examples of the neoplasms most commonly encountered in childhood will complete the study.

Course No. 26: 8:30-10 A.M., Wednesday**A Review of the Pneumoencephalographic Diagnosis of Intracranial Masses**

COLIN B. HOLMAN, M.D.
Rochester, Minn.

The various features of pneumoencephalography with respect to intracranial masses will be reviewed, with emphasis on some of the special technics and other important aids. The course will be illustrated with numerous examples.

Course No. 27: 8:30-10 A.M., Wednesday**Mediastinal Masses**

TED F. LEIGH, M.D., and H. STEPHEN WEENS, M.D.
Atlanta, Ga.

This course is designed to acquaint the listener with the radiologic features of many types of mediastinal masses, some of which are as follows:

1. Cysts: bronchogenic, digestive tract, teratomas, pericardial, celomic, lymphangiomas, parasitic, and others.
2. Solid tumors: thymic, thyroid, parathyroid, esophageal, neurogenic, lymphomas, leukemias, such rare tumors as primary pheochromocytomas and chorionepitheliomas, metastases, and others.
3. Vascular tumors: arterial aneurysms, venous aneurysms, hemangiomas, hematomas, and others.
4. Other lesions: abscesses, granulomas, diaphragmatic herniations, meningoceles, and others.

The clinical and pathologic appearances of these lesions will be discussed where indicated.

Lesions simulating mediastinal masses will be considered, with inclusion of such entities as paramediastinal pulmonary lesions, paraspinal abscesses, bony tumors projecting into the mediastinum.

The course will open with a brief résumé of normal mediastinal anatomy.

Course No. 28: 8:30-10 A.M., Wednesday**Radium and Radioisotope Dosimetry**

ELIZABETH F. FOCHT
New York, N. Y.

The principles and technics of dosage calculations in the use of discrete sources for intracavitary or interstitial therapy are similar for all gamma-emitting isotopes. The fundamentals of distribution, amount, exposure, filter, and dose will be discussed for gamma-ray sources in general and then for particular variations of the more commonly employed elements, such as radium, radon, cobalt, gold, etc.

In some circumstances beta radiation may make a contribution, and it is necessary to evaluate the calculations in such cases.

Radiographic technics for determining spatial arrangement and gadgets for working out the dose in the case of non-rigid distributions will be reviewed. Models of some actual needle and seed distributions will be shown, and the method of making them outlined.

Course No. 29: 8:30-10 A.M., Wednesday**The Principles of Roentgen Diagnosis in Primary Malignant Tumors of Bone**

ROBERT S. SHERMAN, M.D.
New York, N. Y.

Part I. General Concepts

1. Definition of the field: a simple classification of primary tumors of bone suited to the needs of the radiologist.
2. Brief review of recent advances of interest in the roentgen diagnosis of bone tumors.
 - (a) Technical developments.
 - (b) Present status of each malignant primary tumor.
3. Fundamentals in diagnostic roentgenology.
 - (a) Meaning of roentgen diagnosis.
 - (b) Criteria of competent opinion.
 - (c) Special technical considerations.
4. General concepts in the x-ray diagnosis of primary bone tumors.
 - (a) Role of clinician, roentgenologist, and pathologist.
 - (b) Common roentgenological mistakes.
 - (c) Possible pathological pitfalls.
 - (d) Use of biopsy.
 - (e) Differentiation between benign and malignant tumors by x-ray.

Part II. A Demonstration of the Use of the Foregoing Principles

1. The roentgen diagnosis of osteogenic sarcoma and chondrosarcoma.
 - (a) Results of a review of 500 proved tumors.
 - (b) A roentgen classification leading to more systematic and reliable diagnosis.

- (c) Various conditions of bone giving rise to osteogenic sarcoma.

Course No. 30: 8:30-10 A.M., Wednesday

X-Ray Examination of the Small Intestine

LOIS COLLINS, M.D.
Houston, Texas

1. Methods of examination.
2. Indications for examination.
3. Review of anatomy and physiology.
4. Ileus: types; causes; roentgenologist's contribution to management.
5. Functional disorders.
6. Organic disease: Inflammatory.
7. Organic disease: Neoplastic.

Course No. 31: 8:30-10 A.M., Wednesday

Cinefluorography

GEORGE H. RAMSEY, M.D., FRANK L. CAMPETI, M.D.,
and RAYMOND GRAMIAK, M.D.
Rochester, N. Y.

This course will consist of a demonstration of the value of studying the dynamics of a part. Cinefluorographic and image intensification film will be used. Illustrations showing anatomical heart detail and functional activity will be shown. Details of the mechanism of swallowing, not recognized by conventional methods, will be used to "illustrate the value of the cine technics." A variety of scenes, of joints, bladder, ureter, etc., will be used to demonstrate the dynamic values.

Course No. 32: 8:30-10 A.M., Wednesday

The Bodily Fate of Substances as a Basis for Roentgen Diagnosis

EVERETT L. PIRKEY, M.D., and P. K. KNOEFEL, M.D.
Louisville, Ky.

This will be a review of the pharmacology and physiology of various substances used in roentgen diagnosis. Some attempt will be made to explain certain modes of action by means of chemical structure. Interesting practical applications of certain of these substances will also be shown. Particular attention will be paid to the materials used in kidney, liver, and bile-duct diagnosis.

Course No. 33: 8:30-10 A.M., Thursday

Radiotherapy of Breast Cancer

VINCENT P. COLLINS, M.D.
Houston, Texas

The conflicting views on the importance of radiotherapy in breast cancer must be reconciled if a rational plan of therapy is to be evolved. Results of treatment are most often assessed from survival rates, but additional information can be gained from

the course of uncured patients. The reasons for failure and the pattern of recurrence provide a basis for developing treatment policy and technics of radiotherapy which will be presented for the various stages in which breast cancer is encountered.

Course No. 34: 8:30-10 A.M., Thursday

Radiology of the Heart and Great Vessels

J. STAUFFER LEHMAN, M.D.
Philadelphia, Penna.

This course will consider the radiology of the heart and intrathoracic great vessels, with discussion limited to the use of the simpler methods of roentgen examination: conventional fluoroscopy and conventional roentgenography.

Part I will present a brief consideration of the basic embryology, anatomy, and physiology of the heart and great vessels, including the lesser circulation, as related to radiologic diagnosis.

The conduct of adequate fluoroscopy and film study, the analysis of various alterations of the heart and great vessels, and the criteria for evaluation of cardiac chamber enlargements will be presented. Particular emphasis will be placed on dynamic pathophysiological alterations producing selective changes in the size of cardiac chambers and vessels.

(This course continued Friday, Course No. 43.)

Course No. 35: 8:30-10 A.M., Thursday

Fundamentals of Cerebral Angiography

JUAN M. TAVERAS, M.D.
New York, N. Y.

Part I: This presentation will be primarily concerned with laying down a solid anatomical and physiological foundation which will enable the participants to do further work on the subject. The different aspects of technic will be discussed, with reference both to equipment and methods. In the remaining time, material concerning vascular disease (spasm, thrombosis, aneurysms, arteriovenous malformations and fistulas) will be considered.

Part II: Principles of angiographic diagnosis of intracranial neoplasms.

(This course continued Friday, Course No. 44.)

Course No. 36: 8:30-10 A.M., Thursday

Design and Equipment of Radioisotope Laboratories

G. W. MORGAN
Oak Ridge, Tenn.

Practical aspects of the design and equipment of hospital radioisotope laboratories will be discussed, with suggested facilities for different programs utilizing various radioisotopes. Prototype laboratories and facilities will be presented for both diagnostic and therapeutic programs. The presentation will

include laboratories for use of radioisotopes purchased in a form standardized and ready for use as well as for hospitals procuring their isotopes directly from Atomic Energy Commission facilities. The discussion will also include facilities and equipment for more extensive programs involving animal experimentation.

Course No. 37: 8:30-10 A.M., Thursday
Some Fundamentals in Chest Roentgen Interpretation

BENJAMIN FELSON, M.D.
 Cincinnati, Ohio

Chest roentgen interpretation should not merely represent an attempt to correlate particular shadows with specific diseases, but should be approached with an understanding of the basic principles of anatomy, physiology, pathology, and roentgenology involved. Some of these principles will be considered and their practical application illustrated.

Among the subjects to be discussed are:

First Session

1. A method of fluoroscopy.
2. Dionosil bronchography.
3. The "silhouette" sign.
4. The air bronchogram.

Second Session

1. Anatomic variations in the pulmonary fissures.
2. Lobar collapse.
3. Lobar enlargement.
4. The disrupted fissure.

(This course continued Friday, Course No. 46.)

Course No. 38: 8:30-10 A.M., Thursday
The Statistical Point of View
 (How to look a statistic in the face with equanimity)

HAROLD TIVEY, M.D.
 Houston, Texas

The purpose of this course is to review, in a non-mathematical fashion, those statistical methods useful to the practicing radiologist both in the evaluation of his own results and the equally critical examination of the published work of others.

A brief appraisal of some current methods of presentation of data will be given, with particular emphasis on the basic concepts, the implications of such methods, and the logical pitfalls which may be encountered by both the investigator and his readers. The intent is to enable us to face the ordinary statistics with adequate equanimity and deserved skepticism.

The general problem of evaluation of survival time data in patients with malignant disease will be discussed. There are now available methods by which the proportion of patients cured and the

times of death of those patients not cured may be predicted long in advance of the ultimate outcome of the series. Such predictions appear to be reliable within the confidence limits which can be placed upon the results of the usual series of 100 patients if the analysis is made as early as the time required for the first half of the patients in the series to die. (For many tumors, this interval will be less than three years after the last patient of the series is treated.) These methods will be presented by means of appropriate examples.

Mimeographed notes and references will be furnished those who wish to explore such problems in greater detail.

(This course continued Friday, Course No. 47.)

Course No. 39: 8:30-10 A.M., Thursday
Diseases of the Joints

LESTER W. PAUL, M.D.
 Madison, Wisc.

This course will cover the roentgenologic aspects of the more common types of arthritis, with correlation of the roentgen findings and pathologic alterations so far as is possible. Rheumatoid arthritis, infectious arthritis, and degenerative disease of the peripheral joints will be considered in this manner, with emphasis upon the recognition of early roentgenographic changes. The remainder of the period will be given over to a presentation of some of the less common lesions of the joints, including various neoplasms and tumor-like processes.

Course No. 40: 8:30-10 A.M., Thursday
Examination of the Colon

CHARLES W. YATES, M.D.
 Houston, Texas

Review will be made of the various methods of examination of the colon, with the advantages and disadvantages associated with each method. Specific lesions will be demonstrated with slides.

Course No. 41: 8:30-10 A.M., Thursday
Fundamental Considerations in Radiation Biology

TITUS EVANS, Ph.D.
 Iowa City, Iowa

The biologic aspects of the following topics will be considered.

1. Mechanisms of radiation-induced injury.
2. Variations in effects related to changes in quantity or quality of radiation.
3. Variation in radiosensitivity of tissues.
4. Modification of radiation reactions.
5. Protraction.
6. Fractionation.
7. The latent period.

8. Aplasia.
9. Neoplasia.

An attempt will also be made to discuss possible relationships of these biologic factors to certain problems in radiation therapy and protection.

Course No. 42: 8:30-10 A.M., Friday
Chemotherapeutic Agents Useful in the Treatment of Malignant Disease

CLYDE O. BRINDLEY, M.D.
Bethesda, Md.

The malignant conditions to be discussed include carcinoma of the breast, bronchus, ovary and prostate, the lymphomas, the leukemias, myeloma, and melanoma. For each of these a comparison is made of the effectiveness of several of the well tested chemotherapeutic agents now available for treatment of malignant disease. These include the antifolates, purine analogues, various alkylating agents, the adrenal steroids and their newer derivatives, estrogens, androgens, colchicine derivatives, and some new antibiotic agents with antitumor activity.

Of particular interest are the newer alkylating agents in chronic leukemia and in carcinomas of the breast, bronchus, and ovary, the new adrenal steroid derivatives in the lymphomas, and the purine analogues in acute leukemia.

Course No. 43: 8:30-10 A.M., Friday
Radiology of the Heart and Great Vessels by Conventional Methods. Part II.

J. STAUFFER LEHMAN, M.D.
Philadelphia, Penna.

This session will be concerned with individual cardiovascular conditions.

The pathophysiological changes in various types of heart disease, and the resultant alterations of the size and shape of the heart and great vessels, as radiologically manifest, will be considered.

Continued emphasis on "chamber analysis" will be stressed. Time will permit of basic consideration of only the more common types of acquired and congenital cardiovascular disease.

The course is specifically designed as an evaluation of the simpler conventional methods in radiologic diagnosis. The positive values and limitations of such examination will be discussed.

(Continued from Thursday, Course No. 34.)

Course No. 44: 8:30-10 A.M., Friday
Fundamentals of Cerebral Angiography

JUAN M. TAVERAS, M.D.
New York, N. Y.

(Continued from Thursday, Course No. 35.)

Course No. 45: 8:30-10 A.M., Friday
Recovery From Radiation Injury

LEON O. JACOBSON, M.D.
Chicago, Illinois

Data are available that show conclusively that survival of laboratory animals subjected to a single lethal dose of total-body x-radiation can be significantly increased by measures instituted before or after the radiation injury has been sustained. Evidence is also available that the injury produced by repeated or chronic exposure to radiation can be altered favorably. The effective prophylactic measures include the administration of such materials as estrogens, cysteine, and glutathione. "Therapeutic" measures or, more correctly, measures instituted after irradiation injury, include spleen-shielding, intraperitoneal implantation of splenic tissue, intraperitoneal implantation of marrow suspensions, intravenous or intraperitoneal injection of homologous bone marrow suspensions, and related techniques. Evidence is abundant that heterologous tissue (guinea-pig bone marrow to rabbit, mouse liver or spleen to rabbit, rat bone marrow to mouse) is also effective. Although the mechanisms of action of these "prophylactic" and "therapeutic" agents or measures are not known, the evidence at hand tends to indicate that they are different and possibly unrelated.

It has been postulated in various publications that the injected tissue provides a humoral substance or group of substances capable of reversing the radiation inhibitions in the cells of the body and thus bringing about functional reconstitution of hematopoietic tissues, reducing the mortality of the recipient animals. More recent evidence indicates that this theory is only partially correct and that heterologous tissue, when injected into irradiated animals, colonizes the hematopoietic tissue of the recipient and is responsible, at least in part, for the complete cellular reconstitution that is observed under the most favorable conditions.

Course No. 46: 8:30-10 A.M., Friday
Some Fundamentals in Chest Roentgen Interpretation

BENJAMIN FELSON, M.D.
Cincinnati, Ohio

(Continued from Thursday, Course No. 37.)

Course No. 47: 8:30-10 A.M., Friday
The Statistical Point of View

HAROLD TIVEY, M.D.
Houston, Texas

(Continued from Thursday, Course No. 38.)

Course No. 48: 8:30-10 A.M., Friday
The Skeletal Manifestations of Developmental Disorders in Infants and Children

JOHN R. HODGSON, M.D.
Rochester, Minn.

In this course, examples of congenital developmental abnormalities of the skeleton will be shown. The material will be presented in atlas form. Discussion of the more commonly encountered and obvious abnormalities will be brief. More time will be devoted to those conditions in which the diagnosis may not be immediately apparent.

Course No. 49: 8:30-10 A.M., Friday
"Custom-Fitted" Radiation for Cervical Cancer

ANTOLIN RAVENTOS, M.D.,
and GEORGE LEWIS, M.D.
Philadelphia, Penna.

Roentgen and radium technics for cervical cancer will be reviewed, with emphasis on adaptation of the procedure to the individual patient by cooperation between radiologist and gynecologist. The following general outline will be observed:

1. Aims of radiation therapy in cervical carcinoma
2. Roentgen therapy
 - Relationship to radium
 - Time-dose factors
 - Technics
 - Portal localization: external, intravaginal
 - Energy: 200 to 20,000 kilovolts
3. Radium
 - Standard technics of application
 - Dosage control
4. Evaluation of results
 - How to follow patients
 - Recurrence and radioresistance

Complication rates
Survival rates

5. New adjuncts
 - Ir¹⁹² beads in nylon tubing
 - Au¹⁹⁸: colloidal interstitial and grain implants

Course No. 50: 8:30-10 A.M., Friday
Aids, Gadgets, and Useful Tips for Beam and Dose Control

JESSHILL LOVE, M.D.
Louisville, Ky.

The object of this course is to present ideas for beam and dose control in x-ray and radium therapy. During the presentation various devices will be shown to aid in obtaining a contour of the patient, applying dosimetry methods and directing the incident and exit beam. The value of shaping irregular fields with space absorbers will be discussed, and a simple gadget for the purpose will be demonstrated. The question of the use of a bolus will be introduced.

Technical data for positional films (200 to 2,000 kv) with the treatment machine in position will be given. A new idea for positional films made during rotation of the patient will be discussed, and several of the films exhibited.

Special devices such as calipers and grids used to localize mouth tumors and a positional technic for head and neck tumors will be shown.

There are several aids to assure even distribution of the sources in a radium implant. Dosimetry and dose calculation of the implant may be simplified to some degree by an r-per-hour table.

Have you recently checked the alignment of the central x-ray beam with center of the port of your therapy machine? Have you made radioautographs of your radium sources? How is your penumbra?

The subjects will be presented by several speakers. Due credit will be given to the contributors, authors, and inventors of each of the subjects and devices presented. Audience participation will be encouraged.



ANNOUNCEMENTS AND BOOK REVIEWS

THE AMERICAN BOARD OF RADIOLOGY

The Spring 1957 examination of the American Board of Radiology will be held at the Hotel Floridian, Tampa, Florida, April 1-6, inclusive. The deadline for filing applications is Jan. 1, 1957.

The Fall 1957 examination will be held at the Shoreham Hotel, Washington, D. C., Sept. 23-28, inclusive. The deadline for filing applications for this examination is June 1, 1957.

BALTIMORE CITY MEDICAL SOCIETY RADIOLOGICAL SECTION

At a recent meeting of the Radiological Section of the Baltimore City Medical Society, Dr. John Dennis was elected Chairman and Dr. Nathan B. Hyman, 1805 Eutaw Place, Baltimore 17, Secretary-Treasurer.

LOS ANGELES RADIOLOGICAL SOCIETY

The following officers have been elected by the Los Angeles Radiological Society: President, Dr. Hubert J. Prichard; Vice-President, Dr. Richard A. Kredel; Treasurer, Dr. Putnam C. Kennedy; Secretary, Dr. Lewis J. Peha, 405 North Bedford Drive, Beverly Hills.

MARYLAND RADIOLOGICAL SOCIETY

At the annual meeting of the Maryland Radiological Society, June 16, 1956, the following officers were elected: Dr. William Thomas, Annapolis, President; Dr. John Dennis, Baltimore, Vice-President; Dr. Nathan B. Hyman, 1805 Eutaw Place, Baltimore 17, Secretary-Treasurer.

MEMPHIS ROENTGEN SOCIETY

At a recent meeting of the Memphis (Tenn.) Roentgen Society the following were elected to office: Dr. Benjamin E. Greenberg, President; Dr. David S. Carroll, Vice-President; Dr. Dan C. Gary, 36 So. Bellevue, Memphis 4, Secretary-Treasurer.

NEW ENGLAND ROENTGEN RAY SOCIETY

The following officers have been elected by the New England Roentgen Ray Society for the coming year: President, Dr. Leslie K. Sycamore, Hanover, N. H.; Vice-President, Dr. Harvey R. Morrison, Boston; Secretary, Dr. Raymond A. Dillon, 24 Wedgemere Avenue, Winchester, Mass.; Treasurer, Dr. Magnus I. Smedal, Boston.

AMERICAN CANCER SOCIETY

The Scientific Session to be held in conjunction with the Annual Meeting of the American Cancer

Society at the Park Sheraton Hotel, New York, N. Y., Oct. 29 and 30, will be devoted to Endocrines and Cancer. All physicians and medical students are invited to attend. Further details of the complete program can be procured about Sept. 1 from American Cancer Society, Professional Education Section, 521 West 57th St., New York 19, N. Y.

CONTINUATION COURSE IN RADIOLOGY UNIVERSITY OF MINNESOTA

The University of Minnesota will present a continuation course for radiologists at the Center for Continuation Study, November 5 to 9, 1956. The subject of this year's course will be Radiation Therapy. Radiation physics and biology will be considered, and two major groups of neoplasms will be discussed—gynecological tumors and tumors of the maxillofacial area, pharynx, and larynx.

Guest speakers will include Dr. Hans-Ludwig Kottmeier, Director, Gynecological Department of Radiumhemmet, Stockholm; Dr. J. A. del Regato, Director, Penrose Cancer Hospital, Colorado Springs; Dr. Henry S. Kaplan, Professor of Radiology, Stanford University School of Medicine, San Francisco; Dr. John B. Graham, Instructor in Gynecology, Harvard Medical School, Boston; Dr. Titus C. Evans, Radiation Research Laboratory, State University of Iowa College of Medicine, Iowa City; and Dr. Harold Tivey, Jefferson Davis Hospital, Houston, Texas. Dr. Kottmeier will deliver the annual Leo G. Rigler Lecture on Wednesday evening, November 7.

The program will be presented under the direction of Dr. Leo G. Rigler, Professor and Head, Department of Radiology, and Donn G. Mosser, Assistant Professor and Director, Division of Radiation Therapy.

AWARDS IN RADIOLOGICAL RESEARCH JAMES PICKER FOUNDATION

On behalf of the James Picker Foundation, the National Academy of Sciences-National Research Council announces the continued availability of funds in support of radiological research. The program includes Grants-in-aid, Grants for Scholars, and Fellowships in Radiological Research.

Grants-in-aid are designed to encourage research offering promise of improvement in radiological methods of diagnosis or treatment of disease.

Grants for Scholars are a transitional form of support, designed to bridge the gap between the completion of fellowship training and the period when the young scientist has thoroughly demonstrated his competence as an independent investigator. A grant of \$6,000 per year will be made directly to the Schol-

ar's institution as a contribution toward his support, or his research, or both.

Fellowships in Radiological Research are open to candidates seeking to gain research skills leading to investigative careers in the field of radiology. While persons from closely related disciplines are eligible to apply, candidates whose training has been directly in the field of radiology will receive preference under this program. Candidates must hold the M.D., Ph.D. or Sc.D. degree, or the equivalent.

Applications for the fiscal year 1957-1958 must be submitted on or before Dec. 1, 1956. Further details and application blanks may be obtained from the *Division of Medical Sciences, Room 310, National Academy of Sciences-National Research Council, 2101 Constitution Ave., N. W., Washington 25, D. C.*

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE SPINE. ANATOMICO-RADIOGRAPHIC STUDIES. DEVELOPMENT AND THE CERVICAL REGION. By LEE A. HADLEY, M.D., Senior Attending Roentgenologist, Syracuse Memorial Hospital; Clinical Associate Professor of Public Health, New York State College of Medicine; Consultant in Radiology, Syracuse State School, Syracuse, N. Y. A volume of 156 pages, with numerous illustrations. Published by Charles C Thomas, Springfield, Ill., 1956. Price \$6.50.

MEDICAL EFFECTS OF THE ATOMIC BOMB IN JAPAN. Edited by ASHLEY O. OUGHTERSON, Clinical Professor of Surgery, Yale University School of Medicine; Attending Surgeon, Grace-New Haven Community Hospital; and SHIELDS WARREN, Pathologist, New England Deaconess Hospital; Professor of Pathology, Harvard Medical School. A volume of 478 pages, with numerous illustrations and tables. Published by McGraw-Hill Book Co., Inc., 1956. Price \$8.00.

ROENTGENOLOGY OF THE HEART AND GREAT VESSELS. By ROBERT N. COOLEY, M. D., Professor and Chairman, Department of Radiology, University of Texas, Medical Branch, and ROBERT D. SLOAN, M.D., Professor and Director of the Department of Radiology, University of Mississippi Medical Center. Renewal pages for Diagnostic Roentgenology. Edited by ROSS GOLDEN, M.D., Visiting Professor of Radiology, University of California at Los Angeles; Emeritus Professor of Radiology, College of Physicians and Surgeons, Columbia University; Formerly Director of the Radiological Service, Presbyterian Hospital, New

York. 306 pages, with 195 figures. Published by Williams & Wilkins Co., Baltimore 2, Md., 1956. Price \$15.00.

THE HAZARDS TO MAN OF NUCLEAR AND ALLIED RADIATIONS. Report of a Committee Appointed by the British Medical Research Council. Presented by the Lord President of the Council to Parliament by Command of Her Majesty, June 1956. 128 pages. Published by Her Majesty's Stationery Office, London. Price 5s. 6d. Net.

RENAL ANGIOGRAPHY IN EXPERIMENTAL HYDRO-NEPHROSIS. Acta radiologica Supplement 136. By HANS IDBOHRN. From the Roentgen-Diagnostic Department of the University Hospital, Lund, Sweden (Director: Professor Olle Olsson). A monograph of 86 pages, with numerous illustrations. Published by Acta radiologica, Stockholm 2, Sweden, 1956. Price Sw. Kr. 20:-

OBSERVATIONS ON THE MIGRATION OF SOME LABELLED SUBSTANCES BETWEEN THE URINARY BLADDER AND THE BLOOD IN THE RABBIT. Acta radiologica Supplement 135. By SVEN ERIK ENGLUND. From the Isotope Laboratory, Department of Obstetrics and Gynecology (Head: Prof. P. Wetterdal), Sabbatsbergs Sjukhus, Karolinska Institutet, Stockholm, Sweden). A monograph of 80 pages, with 50 figures and 2 tables. Published by Acta radiologica, Stockholm 2, Sweden, 1956. Price Sw. Kr. 25:-

TOMOGRAPHIC STUDIES ON THE NORMAL AND INJURED KNEE. Acta radiologica Supplement 138. By STIG FAGERBERG. From the Roentgen Department (Director: Professor F. Knutsson), University Hospital, Uppsala, Sweden. A monograph of 94 pages, with 51 figures. Published by Acta radiologica, Stockholm 2, Sweden, 1956. Price Sw. Kr. 30:-

ON PARALLAX AND VARIATIONS IN THE STEREO-SCOPIC IMAGE, WITH A VIEW TO STEREOFLUOROSCOPY. Acta radiologica Supplement 139. By TAUNO MANNILA. From the Radiological Department (Head at the time of the investigation: Professor Carl Wegelius, M.D.), the Medical Out-Patient Clinic of the Helsinki University Hospital, and the Department of Scientific Radiology (Head: Professor Carl Wegelius, M.D.), the University of Turku, Finland. A monograph of 108 pages, with 40 figures and 12 tables. Published by Acta radiologica, Stockholm 2, Sweden. Price Sw. Kr. 25:-

ÜBER DIE TECHNIK DER SIMULTANEN TELEFILM-PLANIGRAPHIE. Acta radiologica Supplement 137. By VIDAR BACKLUND. From Zentralen Röntgenklinik des Krankenhauses St. Göran,

Stockholm (Chefarzt: Prof. Dr. Med. Nils Westermarck). A monograph of 124 pages, with numerous illustrations and tables. Published by Acta radiologica, Stockholm 2, Sweden, 1956. Price Sw. Kr. 25:-

NORME PER LE PROTEZIONI CONTRO LE RADIAZIONI IONIZZANTI. Prepared by F. FOSSATI, P. GALLONE, L. PARMEGGIANI, C. POLVANI, AND M. SCOLARI. With a preface by Prof. L. TURANO, Direttore dell'Istituto di Radiologia dell'Università di Roma, *Presidente*, Comitato per le Protezioni Radiologiche, Società Italiana di Radiologia Medica. A volume of 260 pages, with 22 figures and 39 tables. Published by Ulrico Hoepli, Milan, 1956.

Book Reviews

DIAGNOSIS OF CONGENITAL HEART DISEASE. A Clinical and Technical Study by the Cardiology Team of the Pediatric Clinic, Karolinska Sjukhuset, Stockholm: SVEN R. KJELLBERG, EDGAR MANNHEIMER, ULF RUDHE, AND BENGT JONSSON. A volume of 650 pages, with 581 illustrations. Published by Year Book Publishers, Inc., Chicago, 1955. Price \$22.00.

This book represents the work of two roentgenologists and two cardiologists collaborating in a study of 396 cases of congenital heart disease at the Pediatric Clinic of Karolinska Hospital, Stockholm. The authors state that many of the cases were completely investigated by more than the minimum studies because they wished to compare the results obtained by different methods of approach. This has resulted in a wealth of angiocardiographic material, which will be of particular interest to the radiologist. The angiocardiograms are well reproduced in adequate size. There is perhaps slightly less emphasis on electrocardiography than there is in some clinics in this country, but the subject receives reasonably complete treatment for each anomaly considered. Electrokymography is fully discussed, and cardiac catheterization was routinely done. There is also information about phonocardiography and, of course, the clinical features and plain film findings. Many illustrations of pathologic specimens and diagrams of physiologic findings are included. The description of equipment and technics is good.

The allotment of space to the various conditions is commendable. There is extensive discussion of the more common lesions and their many variations, while the space devoted to the less important anomalies is correspondingly reduced.

The authors report briefly three deaths associated with angiocardiography and warn against repeated injections and against the danger of air embolism in the case of right-to-left shunt. They also record one death from cardiac catheterization.

In summary, this book contains a wealth of in-

formation concerning all phases of congenital heart disease and is highly recommended.

THE THYROID. A Fundamental and Clinical Text with Sixty Contributors. Edited by SIDNEY C. WERNER, M.D., Sc.D. (Med.). A volume of 790 pages, with 130 illustrations and 65 tables. Published by Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York, N. Y., 1955. Price \$20.00.

This comprehensive text is divided into three parts: (I) The Normal Thyroid, including physiology and mechanisms of drug action. (II) Laboratory Methods. (III) Diseases of the Thyroid, including evaluation and recommendations on the medical, radiation (including isotopes), and surgical management.

Of particular interest to radiologists are the excellent and practical sections dealing with laboratory methods. These eighty-six pages cover radioiodine physics, with dose calculations, radiation dosage ranges, and health hazards calculated for both patients and contacting personnel. The possible carcinogenesis of radioiodine is evaluated in the light of present knowledge. The subsection on instrumentation for the use of radioiodine will serve only as an introduction to the subject, but that on clinical radioiodine procedures is excellent and comprehensive. I^{131} uptake procedures are outlined with evaluation of results for both adults and children.

The references offered in connection with each chapter include literature up to 1953.

This is probably the most valuable general text available on the thyroid.

ROENTGEN INTERPRETATION OF FRACTURES AND DISLOCATIONS. By JOSEPH LEVITIN, M.D., Chief, Department of Radiology, Mount Zion Hospital, San Francisco, Calif., and BEN COLLOFF, M.D., Associate Chief, Department of Orthopedic Surgery, Mount Zion Hospital, San Francisco, Calif. A volume of 266 pages, with 258 illustrations. Published by Charles C Thomas, Springfield, Ill., 1956. Price \$7.75.

This handy little manual gives an unusually complete coverage of the major fractures which may involve the various parts of the body. The discussion includes surgical considerations and general principles of treatment which are of great assistance in evaluating the injury in terms of the entire area involved rather than merely in regard to position and alignment of the particular bone structures. Much of the information presented, while fundamental, is at the medical school level.

The book is highly recommended for the radiologist who has had infrequent contact with some of the more elementary aspects of fractures and who wishes to have at hand a ready source of reference covering the basic principles of interpretation and treatment.

Illustrations consist principally of line drawings, although a few roentgenograms are reproduced.

RÖNTGENDIAGNOSTIK DES HÜFTGELENKS. Fortschr. a. d. Geb. d. Röntgenstrahlen. Ergänzungsband 77. By Prof. Dr. Med. R. GLAUNER, Chefarzt der Röntgen- und Radiumabteilung am Marienhospital, Stuttgart, and Doz. Dr. Med. Habil. W. MARQUARDT, Leitender Arzt der Orthopädischen Klinik, "Paulinenhilfe," Stuttgart. A volume of 168 pages, with 293 illustrations. Published by Georg Thieme Verlag, Stuttgart, 1956. Price DM 57.-

In this neat monograph the authors try to convey their ideas to the reader not by lengthy explanations but rather by roentgenograms well chosen from the files of their hospitals. The text is concise and to the point. The roentgenograms are excellent illustrations of practical cases.

The book is divided into fourteen chapters which contain clear descriptions of the various congenital hip joint dysplasias, the disturbances characteristic of the growing adolescent hip, acute and chronic inflammatory conditions, tumors, changes due to systemic diseases, and finally injuries and the arthroses. Particular attention is paid to congenital dislocation. The various measurements of lines and angles in the x-ray film of the infantile hip are described in detail. The authors feel that even the slightest dysplasia or deviation from the accepted norm must be recognized and treated in earliest infancy. Congenital dislocation of the hip should be prevented rather than cured. A delay in treatment by only a few months may be responsible for decades of disability.

Of interest is the chapter on the arthroses, which are divided into primary and secondary. The authors show by means of serial roentgenograms how a slight congenital dysplasia or a disturbance in the juvenile hip may in the course of years relentlessly lead to a severe secondary arthrosis. They also show that, in most cases of secondary arthroses, the original damaging factor in childhood can be ascertained, in retrospect, with a fair degree of accuracy from the x-ray appearances. The best prophylaxis of a subsequent deforming arthrosis is a diminution of the prearthrotic deformity by surgical means in early childhood and the careful regulation of the stresses and strains to which the joint may be exposed.

This book should be of value not only to the radiologist and the orthopedic surgeon but also to the pediatrician and to the general practitioner.

LE CANCER DU PLANCHER DE LA BOUCHE. By MARCEL DARGENT, Professeur Agrégé à la Faculté de Médecine de Lyon, Chirurgien des Hôpitaux, Chef du Service de Chirurgie du Centre Anticancéreux de Lyon, and JEAN PAPILLON, Radiologiste des Hôpitaux, Chef du Service de Radiothérapie du Centre Anticancéreux de Lyon.

With the collaboration of J.-F. MONTBARBON, Assistant de Radiothérapie du Centre Anticancéreux de Lyon. Preface by P. Santy. A volume of 170 pages, with 48 figures. Published by Masson et Cie, 120, Boulevard Saint-Germain, Paris 6^e, 1955. Price 1,800 fr.

This monograph on cancer of the floor of the mouth is the work of a surgeon and radiologist and is based upon their experience with 454 patients.

Etiologic considerations are presented in the first chapter. Alcoholism with cirrhosis or pre-cirrhosis was found in a high percentage of the series studied. Subsequent chapters deal with the gross and microscopic morphologic aspects; problems of diagnosis; surgical treatment, including discussions of anesthesia, tracheotomy, pre- and postoperative care, electro-coagulation, and radiotherapy. Under this last heading are included x-ray therapy (endobuccal and external with conventional and high voltage), radium therapy (implantation, molds, teleradium), and combinations of these several technics.

Following some statistical treatment of their material, the authors complete the work with a summary of their opinions concerning therapeutic indications according to the extent of the tumor and the presence or absence of lymph node involvement.

This little book is well written and can be recommended. The bibliography draws from the world literature.

In Memoriam

HAROLD LESLIE VAN HALTERN, M.D.

Dr. Harold Leslie Van Haltern died on June 23, 1956, of a sudden and massive coronary thrombosis. Dr. Van Haltern was a diplomate of the American Board of Radiology, a member of the Radiological Society of North America and of the American College of Radiology. He was also active in the local unit of the American Cancer Society.

Harold Van Haltern was born in Athena, Oregon, on Aug. 16, 1907. He took his undergraduate work at Texas Christian University in Fort Worth, obtained his M.D. degree from the University of Texas in 1933, and served a years internship at the Robert B. Green Memorial Hospital in San Antonio. Following this, he spent some years in general practice in Texas before taking a three-year residency in radiology at The Henry Ford Hospital, Detroit. Upon completion of his radiology residency, he entered private practice in Pontiac, Mich., where he served as radiologist at Pontiac General Hospital and Pontiac State Hospital. During his residency, he prepared an article on the use of pyridoxine in radiation sickness, and a paper on osteopetrosis is at present in the process of publication.

Besides his many friends and colleagues, Dr. Van Haltern leaves a wife and four children.

ZAC F. ENDRESS, M.D.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Roentgenographic Study of the Variations in the Normal Anterior Cerebral Artery. One Hundred Cases Studied in the Lateral Plane. Arthur A. Morris and Clemmer M. Peck. *Am. J. Roentgenol.* 74: 818-826, November 1955.

The authors are of the opinion that the variations in the anterior cerebral artery are so numerous that great hazards result when diagnoses depend upon angiography alone. They prefer a combined procedure, using pneumoencephalography as well as angiography.

A study was made of a group of 100 patients in whom it was felt that the anterior cerebral arteries were within the limits of normal; for each case there was a normal air study, either a pneumoencephalogram or a ventriculogram. For descriptive purposes, four divisions of the anterior cerebral artery as seen in the lateral projection are recognized. Part I begins at the derivation of the artery from the internal carotid and ends before the vessel encloses the genu of the corpus callosum. This usually includes the derivation of Heubner's artery, the frontopolar artery, and the anterior communicating artery. Part II surrounds the genu of the corpus callosum. Part III begins after the curve of Part II is completed and continues to the first sign of tortuosity in the pericallosal artery. Part IV begins with the first sign of tortuosity in the pericallosal artery and extends to the most distal part of that vessel.

The anterior cerebral artery was found to present a high percentage of variations when analysis was made from a purely roentgenographic standpoint. Various parts of the artery, however, appeared to be subject to fewer variations than others.

Part I was demonstrable in 82 per cent of the cases as a straight horizontal vessel, usually interrupted by an inversion so that the convexity was superior and posterior. A further 13 per cent showed a straight horizontal course parallel to the orbital plate. Failure of the part to fall into one of these categories should be considered of potential diagnostic significance.

Part II undergoes numerous variations. The usual appearance is a narrow curve with the convexity anterior (60 per cent of the authors' cases) but a wide curve with convexity anterior, an acute angulation of 30 to 60°, and even a reverse "S" may be normal.

Part III showed little variation from its usual round, smooth course with the convexity upward. In 16 per cent of the authors' cases there was a downward convexity.

Part IV may take the form of a monophasic, a biphasic, or a triphasic curve, with numerous possibilities of variation in each.

When bilateral filling of the anterior cerebral arteries was obtained from a unilateral injection, it was observed that, if a variation occurred, it was almost always symmetrical. In view of this, the authors have more recently adopted *bilateral* cerebral arteriography as a routine. This has proved of high significance in the control of normal variations and has considerably increased the diagnostic accuracy of the examination.

Excellent line drawings show the principal variations in the four parts of the artery.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Hydroencephalodysplasia. An Anatomicoclinical Picture. J. A. Picaza, G. Cardelle, and R. Martin Jimenez. *J. Neurosurg.* 12: 535-549, November 1955.

Under the designation "hydroencephalodysplasia," the authors discuss a group of cases characterized by extensive dysplasia of the brain and increased intracranial pressure. These lesions are to be differentiated from developmental errors located largely in the cerebrospinal fluid pathways, as malformations of the aqueduct of Sylvius. Such lesions interrupt the circulation, producing congenital hydrocephalus. In hydroencephalodysplasia (H.E.D.) the main defect is in the brain itself.

Of a series of 135 consecutive hydrocephalic cases reviewed by the authors, 23 were classified as hydroencephalodysplasia in contradistinction to congenital hydrocephalus. The clinical picture is characterized by an expressionless face, optic atrophy and ophthalmoplegia, psychomotor arrest, paralysis and spasticity, and convulsions. With congenital hydrocephalus the expression is intelligent and neurologic findings are absent until the condition is quite advanced. Since hydroencephalodysplasia is largely a defect of the neopallium, and all newborn infants are from a practical standpoint functionally decorticate, clinical differentiation of the two conditions is difficult in the first few months of life. Another source of clinical confusion occurs when hydrocephalus is advanced, with brain destruction.

In both conditions the head is enlarged. In hydroencephalodysplasia the skull may be transilluminated by a strong light beam, on account of absence of the brain. This observation, however, is not pathognomonic, as it occurs with advanced hydrocephalus.

Plain films are not diagnostic, but the situation can be readily clarified by ventriculography and arteriography. The two most constant findings on the ventriculogram are (1) absence of some amount of cortex, varying from a small portion (porencephaly) to the entire cortex (apallium), and (2) variation in amount of the brain stem and surrounding malformed structures, which are seen as a triangular shadow in the base of the sagittal plane. Air studies are not well tolerated if the malformations are large, and not infrequently are followed by respiratory syncope or infection. Probably arteriography presents the most pathognomonic picture, though the internal carotid is hypoplastic in the neck, making the procedure difficult. In extreme cases of anencephaly all the important cerebral blood vessels may be absent and the internal carotid may end in a small bunch of fine vessels. In less severe defects, the collateral branches from the middle cerebral artery may be reduced in number and localized to certain areas. The sylvian vessels may be devoid of collateral branches ascending to the cortex, or even without any collateral branches. Care should be taken not to mistake the superficial temporal or meningeal arteries for the cerebral vessels.

The mechanism producing increased pressure in hydroencephalodysplasia differs from that in hydrocephalus. Obstruction alone cannot be accepted as the cause, since in all cases studied there was a large communication between the cortical subarachnoid space and the ventricle through the area of missing brain. The increased pressure could be either a transitory or a permanent result of the imbalance between the production

of fluid and decreased absorption caused by absence of an extensive area of brain and partial closure of the subarachnoid space. In a number of instances cerebrospinal fluid pressure has been controlled by surgical evacuation or simply by tapping. Thus, congenital hydrocephalus is progressive, whereas in hydroencephalodysplasia there is a tendency to stabilization of pressure.

Primary external hydrocephalus with accumulation of cerebrospinal fluid on the external surface of the brain described by Dandy has not been observed by the authors. The presence of large amounts of subdural fluid was seen only as a part of the condition described. This provides a further difference from hydrocephalus, where subdural puncture should be negative.

Pathologically the cases observed revealed all degrees of agenesis of the telencephalon, from porencephaly to anencephaly, and included cyto-architectonic changes and thickening of the arachnoid membrane with closure of the subarachnoid space in certain areas. The skull and meningeal membranes were relatively normal in appearance. This tends to support previous opinion that these malformations are due to an exogenous factor acting late in embryogenesis. Several clinical histories in the group were positive for acquired injury in the last trimester of pregnancy. In hydrocephalus, a genetic factor is believed to act very early in embryogenesis.

Twelve illustrations, including 3 roentgenograms; 3 tables.

C. M. GREENWALD, M.D.
Cleveland Clinic

Ossification in Gliomas. J. Bebin and J. S. Tytus. *J. Neurosurg.* 12: 577-583, November 1955.

Whereas calcification of intracranial tumors is well documented, true ossification in gliomas is almost unheard of. The authors report 2 examples occurring in an astrocytoma of the cerebellum of some twenty-five years duration and in a frontal oligodendroglioma of nine years duration. Calcific density was demonstrated radiographically in both instances. On histologic section, portions of the tumors showed well differentiated membranous bone with trabeculae and bone marrow spaces filled with fibrous connective tissue. Areas of calcification were also present.

The possible origin of osseous tissue in a glioma is briefly discussed. In other tumors, as meningioma, it has been suggested that bone formation occurs secondary to degeneration of tumor cells, or that bone is formed by the multipotential cells that make up the tumor itself. Gliomas, however, are derived from the ectoderm of the primitive neural tube, so that this latter assumption would hardly hold. The authors favor the theory of metaplastic bone formation by direct transformation of embryonic or adult connective tissue into a calcifiable matrix (intramembranous formation). Thus, there could either be transformation of the mesenchymal cells of the blood vessels into osteoblasts, or they might arise from fibroblasts and reticular cells.

Two roentgenograms; 6 photomicrographs.

C. M. GREENWALD, M.D.
Cleveland Clinic

Cerebral Arterial Shunt in the Monkey. Kenneth M. Browne, Wilbert A. Warner, and A. Earl Walker. *J. Neurosurg.* 12: 634-642, November 1955.

It is well known that pressoreceptive reflexes are of

fundamental importance in regulating the cerebral blood flow. An important aspect of this regulation is the effect upon the tonus of the extracranial arteries of the head. Work in the dog and cat has suggested that these extracranial tissues, mainly the vessels of the face, in reality function as shunts and blood reservoirs for the cerebral circulation (Heymans: *Introduction to the Regulation of Blood Pressure and Heart Rate*. Springfield, Ill., Charles C Thomas, 1950). Such animals, however, possess a rete mirabile affording a rich anastomosis between the external carotid artery and the circle of Willis.

Using the rhesus monkey, which possesses a circulation comparable to that of man, the authors studied arteriographically the effect of unilateral stimulation of the cervical sympathetic trunk upon the cephalic circulation. The usual effect of the stimulation was to cause a marked constriction of extracranial branches of the common carotid artery. Constriction of the ipsilateral internal carotid, middle cerebral, and first portion of the anterior cerebral artery occurred less constantly and to a lesser degree. These vasomotor changes were usually associated with an apparent shunting of the injected Thorotrast from the extracranial circulation to the intracranial circulation at the bifurcation of the common carotid artery. Within the brain, a shunting of the contrast medium to the brain stem and to the opposite hemisphere by way of the circle of Willis was evident.

These experiments support Heymans' theory that a reciprocal relationship may exist between the extracranial and intracranial components in the cephalic circulation, and show that a rete mirabile is not a necessary component for the shunt mechanism to operate. It appears that the pressoreceptive reflexes may protect the brain during a fall in the systemic blood pressure by evoking a shunt of extracranial cephalic blood flow to the brain as a result, at least in part, of the lesser degree of vasomotor reactivity of the cerebral arteries as compared to those of the extracranial cephalic circulation.

Eight roentgenograms; 1 table.

C. M. GREENWALD, M.D.
Cleveland Clinic

THE CHEST

Bronchography with Water Soluble Media. Robert T. Rengarts. *Dis. of Chest* 28: 558-567, November 1955.

The author reports a series of 54 cases of tuberculosis in which bronchography was performed with Ioduran B and 5 in which Xumbradil viscous B was used. The main advantage of water-soluble media seems to be their rapid elimination by absorption and expectoration, permitting bilateral bronchography at short intervals. In addition, these media mix readily with bronchial secretions, giving a more uniform outline of the bronchial tree than is obtained with Lipiodol.

Injection was by catheter, following anesthesia of the buccopharyngeal cavity and bronchial tree. The filling of the bronchi was done under fluoroscopic control.

In none of the 5 cases examined with Xumbradil viscous B were the results satisfactory, probably because of limitations of equipment (a 100-ma machine without a spot-film device). There were 4 failures with Ioduran B. In all 4 cases the medium was

coughed up before films could be obtained. Two of the patients had endobronchial disease, a third was injected too rapidly, and the fourth had been poorly anesthetized.

The author found Ioduran B easier to work with and productive of better contrast pictures than Xumbradil viscous B.

Twelve roentgenograms; 1 chart.

LAWRENCE E. FETTERMAN, M.D.
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The Lobes and Interlobar Pleura: Fundamental Roentgen Considerations. Benjamin Felson. *Am. J. M. Sc.* 230: 572-584, November 1955.

The x-ray appearance and significance of the pulmonary septal lines in health and disease are reviewed.

The oblique or major septum parallels the sixth rib to reach the diaphragm several centimeters behind the anterior costophrenic angle. It is not normally demonstrable on a frontal roentgenogram, since the x-ray beam does not strike it tangentially. It is incomplete in 30 per cent of anatomic dissections.

The right horizontal fissure usually meets the oblique septum in the mid-axillary line at the level of the fifth rib or interspace. It reaches the anterior chest wall near the end of the fourth rib. It is absent or insignificant in 25 per cent of anatomical specimens. It is seen on 44 per cent of postero-anterior chest films in adults and 15.5 per cent in children.

Anomalous septa are common. The azygos fissure is visible in about 0.4 per cent of chest roentgenograms. It is rare on the left side. The superior segment of either lower lobe (more commonly the right) may be separated to form a superior accessory lobe. In such cases a septum may be demonstrated roentgenographically lying horizontally at the level of the minor septum, but running posteriorly. In about one-third of specimens an oblique line near the right cardiophrenic angle marks the separation of an inferior accessory lobe. An anomalous fissure forming a middle lobe on the left is present in 8 per cent. It is to be remembered that any lung segment or subsegment may be separated by a fissure.

Sequestered lung is not connected with the bronchial tree and has its own arterial supply. Such lung tissue is usually located in the region of the posterior basal segment of the lower lobe and is covered by its own pleural reflections.

Lobar collapse, or loss of volume of lung tissue on a basis of bronchial obstruction, may be due to an intrinsic mass, intrinsic inflammatory stenosis, extrinsic pressure, or bronchial plugging from foreign material. In the absence of gross bronchial obstruction, decrease in lobe size may result from numerous obstructions of smaller bronchial radicles by secretions or inflammatory swelling. The x-ray diagnosis of diminished lung volume is best based on displacement of the septa, the degree of radiopacity of the affected lobe, and crowding of the lung markings. The "silhouette" sign also is helpful. When an airless portion of lung is contiguous to a border of the heart, great vessels, or diaphragm, the normal sharp outline of that border will be lost on the x-ray film. Additional signs are: unilateral diaphragm elevation, mediastinal shift, narrowing of the thoracic cage, hilar displacement, and compensatory emphysema of uninvolved lobes.

Lobar enlargement produces outward bulging of septal lines. This is seen often in Friedländer's pneu-

monia, and occasionally in pneumococcal pneumonia, tuberculosis, lung abscess, and carcinoma of the lung.

Whenever a pulmonary lesion extends directly across a fissure, the possibility of mycotic infection is suggested. Neoplasms, lung abscess and tuberculosis may also cross septal barriers, but this is seldom detectable radiographically.

Encapsulated fluid accumulations within the fissures are uncommon, but may appear as pseudotumors on the chest film. They may involve the oblique or horizontal fissures, and are usually readily diagnosed when both postero-anterior and lateral films are made.

Six roentgenograms. DON E. MATTHIESSEN, M.D.
Phoenix, Ariz.

Rounded Intrathoracic Lesions. Donald W. Springer, Paul E. Geiger, and Hiram T. Langston. *Am. J. Roentgenol.* 74: 827-849, November 1955.

The authors present a series of 20 cases, all of which had one finding in common, namely, a discrete, circumscribed, solid appearing, smooth-edged density on the chest roentgenogram. In spite of comprehensive examination, including bronchoscopy, the nature of the lesions could not definitely be ascertained preoperatively. A considerable number proved to be malignant, leading the authors to the conclusion that an aggressive attitude is usually the safest one whether such a lesion is large or small, symptomatic or asymptomatic. The pathologic diagnoses were:

Encapsulated empyema.....	1
Benign fibrous mesothelioma.....	1
Thymic cyst.....	1
Teratoma, anterior mediastinum.....	1
Pericardial cyst.....	1
Adenocarcinoma, primary undetermined.....	2
Metastatic carcinoma.....	2
Metastatic sarcoma.....	1
Primary carcinoma.....	6
Primary sarcoma.....	2
Granuloma, probably tuberculous.....	3

Roentgenograms and photomicrographs of each case accompany the report. ALFRED O. MILLER, M.D.
Louisville, Ky.

Persistent Fibrin Bodies Presenting as Coin Lesions. John R. Bumgarner, Max Gahwyler, and D. E. Ward. *Am. Rev. Tuberc.* 72: 659-662, November 1955.

Fibrin bodies are concretions of fibrin which occur in the presence of fluid in the thorax, usually during the stage of beginning resolution and organization of the exudate. A case of far advanced tuberculosis is reported in which induction of pneumothorax was followed by pleural effusion and the development of a fibrin body. This produced a rounded homogeneous density at the right posterior lung base which simulated a "coin" lesion and persisted following resolution of the pneumothorax. It was followed roentgenographically for eight years and did not change appreciably.

Four roentgenograms. JOHN H. JUHL, M.D.
University of Wisconsin

Contrasting Roentgenographic Pulmonary Patterns of the Hyaline Membrane and Fetal Aspiration Syndromes. H. G. Peterson, Jr., and M. E. Pendleton. *Am. J. Roentgenol.* 74: 800-813, November 1955.

Roentgenograms of 147 infants showing signs and

symptoms of respiratory distress not secondary to extrapulmonary disease were obtained in the immediate neonatal period. Forty-one infants with apparently normal pulmonary function were also studied roentgenographically within fifteen minutes to twenty-four hours of birth. The initial examination in all but 4 of the normal group showed uniform and apparently complete aeration of the lungs. In all, the thoracic cage was well expanded, with the ribs in the normal infantile horizontal position and the domes of the diaphragm well down. The only pattern evident in the lungs was that of the bronchovascular tree, which was sometimes prominent in the medial thirds but was not accentuated in the peripheral areas.

In the respiratory distress group, 138 of the 147 infants showed one of two quite different abnormal pulmonary patterns. The pattern most commonly encountered is described as finely reticulogranular, with a general increase in lung density. This was usually quite uniform throughout both lungs. The overall increase in density varied from minimal to marked, a homogeneous or virtually solid density being interpreted as the extreme. Frequently, the air-filled bronchial tree was evident abnormally far out in the peripheral lung fields. In almost all cases the chest appeared to be well expanded, with the lungs appearing to occupy as great a volume as those of an infant with well aerated lungs. There was a normal infantile horizontal posture of the ribs and the domes of the diaphragm were well down.

The second and less common roentgenographic pattern is described as coarse and irregular. In contrast to the previous pattern, this form was marked by its non-uniform appearance. There was a coarse, irregular increase in density, usually following the distribution of the interstitial structures, fanning out into the peripheral lung fields. Associated with the areas of increased density were some areas which appeared to be emphysematous. Where these changes were marked, the chest had a hyperexpanded appearance, with elevation of the upper anterior portions of the ribs above the levels of the corresponding posterior portions. The interesting feature of this coarse, irregular pattern was that it was most marked in the initial roentgenograms and showed substantial clearing within twelve to twenty-four hours, although the lungs were usually not considered entirely normal for a week or more.

From a prognostic point of view, there appears to be a marked difference between the two roentgenographic patterns. Among 104 infants with the reticulogranular pattern there were 23 deaths, whereas only 4 of the 34 showing the coarse irregular pattern died.

On the basis of autopsy studies, the reticulogranular pattern appears to be predominantly associated with the hyaline membrane syndrome, whereas the coarse, irregular pattern was usually associated with fetal aspiration and the post-maturity syndrome.

Eleven roentgenograms; 4 photomicrographs; 2 charts; 2 tables.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Middle-Lobe Syndrome. Gustaf E. Lindskog and Harold C. Spear. *New England J. Med.* 253: 489-495, Sept. 22, 1955.

Seven cases of middle-lobe syndrome, or atelectasis with chronic pneumonitis involving the right middle lobe, are presented to illustrate the wide variety of middle-lobe lesions which cannot be differentiated with certainty except by operation and pathological study.

The cases reported include non-specific atelectasis and chronic pneumonitis with secondary bronchiectasis; bronchogenic carcinoma; atelectasis and organizing pneumonitis secondary to tuberculous hilar lymphadenitis; parenchymal tuberculosis; chronic abscess with organizing pneumonitis; acute pneumonitis with resolution; lipid pneumonia.

While atelectasis and pneumonitis as a result of bronchial compression may occur in any lobe, the right middle lobe bronchus is particularly susceptible because of its small caliber and the cluster of lymph nodes surrounding it. The predominant symptoms are chronic cough, recurrent respiratory infections, wheezing, hemoptysis, chest pain, non-specific easy fatigability, malaise, and weight loss.

The radiologic findings consist of a triangular or quadrilateral shadow well visualized on the right lateral view. The horizontal fissure is depressed. The findings must be differentiated from interlobar effusion and from a prominent right border of the heart with elevation of the right leaf of the diaphragm. Bronchograms may be helpful in confirming obstruction or atelectasis. Bronchoscopy will often reveal stenosis of the bronchus, but may be indeterminate.

Twelve roentgenograms.

SHOZO IBA, M.D.
Downey, Calif.

Difficulties in the Diagnosis of Coexistent Bronchogenic Carcinoma and Active Pulmonary Tuberculosis. P. Wayl. *Dis. of Chest* 28: 568-573, November 1955.

With tuberculosis now becoming a disease of older age groups, and bronchogenic carcinoma increasing in incidence, more cases of their coexistence are being encountered. During 1953 the author observed 3 examples of this type.

In all 3 cases, the history, x-ray findings, and sputum studies were those of tuberculosis. In each instance the sputum cultures became negative following therapy, and some improvement was noted, although this was variable. In Case II, carcinoma was suspected because of a large hilar mass, and bronchial washings were positive. In the remaining cases, bronchoscopy was negative in 1 and showed "excess secretion and mucosal swelling" in the other. At operation, all 3 patients were found to have carcinoma.

Experimental studies show no antagonism between cancer and tuberculosis. Indeed, there may even be a causal relationship between them. Carcinoma as a debilitating disease may lower resistance to tuberculosis or result in activation of latent infection. On the other hand, cancer has been described as developing in old tuberculous cavities, depending possibly upon chronic irritation or metaplasia of epithelial tissue.

The autopsy incidence of cancer in tuberculous patients has been shown to be 1.4 per cent. With an estimated 400,000 cases of pulmonary tuberculosis in the United States, therefore, there may be as many as 6,000 cases of coexistent disease waiting to be discovered.

Atelectasis and severe pain accompanied by wheezing and hemoptysis, in the absence of pleural complications, occur more frequently in cancer than in tuberculosis. Early bronchoscopy with cytologic examination may also help in determining the presence of cancer.

Five roentgenograms.

LAWRENCE E. FETTERMAN, M.D.
Cleveland City Hospital

Healing of Tuberculous Cavities with Conservation of Their Lumina by Antibiotics (Isoniazide). "Chemical Casectomy." Pablo Purriel and Olga Muras. *J. franç. de méd. et chir. thorac.* 9: 601-620, 1955. (In French)

The healing of tuberculous cavities is accomplished by three mechanisms:

1. Closure of the cavity, with disappearance of its lumen, the lesion being transformed into a narrow cicatrix.
2. Obstruction or closure of the bronchus with filling of the cavity, retraction of its walls, and eventual formation of a fibrous nodule.
3. Elimination of caseous material, smoothing of the wall, connective-tissue proliferation, and maintenance of bronchocavernous communications, resulting in a persistent cavity without specific activity, resembling the residual cavities of suppurative pneumonia (open healing cavity).

This report is based on 24 clinical cases, 8 of which were studied histologically. All were treated by Isoniazide, with healing and persistence of an open cavity simulating the appearance of pneumatocele. This type of healing is designated "chemical casectomy."

Eighteen roentgenograms; 10 photographs and photomicrographs.

CHARLES M. NICE, JR., M.D.
University of Minnesota

Sarcoidosis: Improvement in Chest X-Ray Shadows During Pregnancy. R. L. Aikens and C. J. W. Beckwith. *Dis. of Chest* 28: 580-583, November 1955.

A case of sarcoidosis showing marked regression roentgenographically during the latter part of pregnancy is reported. A 22-year-old white woman in the fifth month of pregnancy was found on routine examination (February 1953) to have increased hilar markings and some bilateral parenchymal infiltration. The tuberculin patch test was slightly positive but gastric washings were negative on culture. Earlier survey films (1947 and 1949) had been normal. Examinations on June 6 and July 7 showed improvement, and a film obtained following delivery (July 22) was essentially normal. Over the next fourteen months, however, there was a progressive return of the earlier abnormalities. Slight dyspnea developed. Splenomegaly was first noted in February 1954. A biopsy of a lymph node the following month showed sarcoidosis.

Whether the changes described are incidental to the course of the disease or are due to some physiological body alteration associated with pregnancy cannot be determined on the basis of a single case.

Four roentgenograms; 1 photomicrograph.

LAWRENCE E. FETTERMAN, M.D.
Cleveland City Hospital

Pseudotumoral Forms of Mediastinal Sarcoidosis Strictly Unilateral. P. Jacob. *J. franç. de méd. et chir. thorac.* 9: 696-698, 1955. (In French)

The author reports 2 cases of unilateral enlargement of the right paratracheal and hilar lymph nodes, which on biopsy proved to be sarcoidosis.

Two roentgenograms.

CHARLES M. NICE, JR., M.D.
University of Minnesota

Pulmonary Microlithiasis. Microlithiasis Alveolaris Pulmonum. G. Kent, E. S. Gilbert, and H. H. Meyer. *Arch. Path.* 60: 556-562, November 1955.

The authors report a case of a rare form of pulmonary

calcification, named "microlithiasis alveolaris pulmonum" by Puhr in 1933 (*Virchows Arch. f. path. Anat.* 290: 156, 1933). The essential feature of the condition is a striking roentgenographic opacity resembling miliary tuberculosis, in contrast to almost complete absence of symptoms. The roentgen picture is produced by innumerable intra-alveolar "calculi" throughout the lungs.

Fourteen cases of pulmonary microlithiasis have been recorded. Judging from the literature, the disease is slowly progressive, the longest period of observation being twenty-five years. From the evidence at present available, the authors believe that it is the result of a peculiar exudative response to a variety of conditions.

One roentgenogram; 5 photomicrographs.

Silicosis in a Large Foundry. E. Bertschi and E. Stiefel. *Schweiz. med. Wchnschr.* 85: 1114-1117, Nov. 12, 1955. (In German)

In 1954 an x-ray survey of 603 workers in a large Swiss foundry revealed a 30 per cent incidence of silicosis (22.7 per cent Stages 0-1; 7.3 per cent Stages 1-3). The frequency of silicotic changes did not depend on the type of occupation but on the location of the working place. In night-shift workers, who were particularly exposed to quartz dust, the roentgenologic findings were, surprisingly, no different from those in other groups. Only after exposures of at least twenty years were distinct silicotic changes found in the lungs. A few Stage 1 lesions, however, were observed after exposures of eleven to fifteen years.

On comparing the findings of this check-up with the results of a similar x-ray study in 1949, an increase of positive silicosis findings from 23.5 per cent to 30 per cent was noted. This increase involved exclusively the initial stages, 0-1. The roentgenograms in the two surveys were taken by the same x-ray laboratory and were evaluated by the same roentgenologist, and the employee exposure time was about the same. In the five-year interval there was a definite progression of the x-ray findings in 16 per cent. This was most marked in the steel workers, 42 per cent of whom showed progressive involvement. The incidence of silicosis was also higher in the steel foundry than in the other foundries (13 per cent as against 5 to 8 per cent).

Dust measurements by two different methods resulted in inconsistent findings. In a number of working places ruled free of silicosis hazard by one of the methods, the x-ray survey revealed a considerable incidence of positive findings. Certain groups of cleaners, who worked on castings after the quartz dust had been removed, showed the same x-ray findings as other workers, although the absence of quartz dust at their working places was clearly evident. On the basis of this experience and other considerations, the authors raise the question of whether the x-ray findings are really the expression of a true silicosis or whether they are produced by soiling of the lungs by coal, iron, or dust from castings. They are of the opinion that a re-evaluation of the x-ray findings in silicosis should be considered. They believe that it is not correct to connect any additional lung disturbances such as asthmatic bronchitis and tuberculosis with a coexisting minor foundry silicosis, particularly when the cases occur in foundries which apparently do not present any silicosis hazards. An increased frequency of these other

diseases would be noted if the beginning stages of silicosis were responsible for their development.

Ten tables. HERBERT C. POLLACK, M.D.
Chicago, Ill.

Roentgenologic Findings in the Lungs of Corundum Melters. H. Bohlig. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 83: 678-686, November 1955. (In German)

Exposure to fumes generated during the melting of corundum (aluminum oxide, Al_2O_3) causes a particular type of pneumoconiosis, sometimes called aluminosis. It was first reported in America by Shaver and Riddell (*J. Indust. Hyg. & Toxicol.* 29: 145, 1947. *Abst. in Radiology* 50: 421, 1948). The condition is significant from the point of view of workmen's compensation, since corundum is used in the manufacture of abrasives for the steel industry.

The roentgen findings consist of an increased pulmonary network, extending into the middle and lower lung fields, with superimposed fine "graininess" and/or "spotting," sometimes coalescing to form larger, "streaky-cloudy" densities. The hili are enlarged (the upper mediastinum is sometimes widened), and in later stages fibrotic strands appear in the upper lobes, and scarring with subsequent emphysema enters the picture. In this phase, bronchography will demonstrate bronchial changes (distortion, dilatation, etc.).

Although prognosis is generally poor, there had been no deaths in the series of 13 cases reported in this paper. Nor were there any instances of bronchopneumonic complications, of spontaneous pneumothorax, or of associated pulmonary tuberculosis, although these have been described as common features by other authors.

Ten roentgenograms; 1 table.
E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

THE CARDIOVASCULAR SYSTEM

The Artificially Produced Stomach Bubble. A Radiographic and Cineradiographic Aid in the Study of Cardiomegaly. Eliot Corday, Milton Elkin, and Herbert Gold. *Dis. of Chest* 28: 506-514, November 1955.

The authors present a simple method of determining downward enlargement of the heart by the use of the stomach bubble for contrast. The patient drinks 7 oz. of a commercial carbonated beverage, after which a routine postero-anterior chest film is taken. Following this, other films may be obtained or fluoroscopy may be done.

This procedure was followed in 180 persons, of whom 98 had normal hearts and the remainder were suffering from various heart conditions. In nearly all instances, a satisfactory gas bubble was produced, measuring 8 to 12 cm. in length and outlining the left leaf of the diaphragm. A few poor results were attributed to previously ingested food, a large splenic shadow, or other soft-tissue interference.

The unenlarged heart seldom produced a roentgen defect in the stomach bubble. In 10 of the 57 satisfactory films on persons with cardiac enlargement, the frontal surface area of the heart was seen to be 16 to 46 per cent larger than it appeared on routine roentgenography. The cardiac diameters were not significantly altered, however. Downward enlargement was noted in patients with hypertensive or arteriosclerotic heart

disease. Patients with rheumatic heart disease rarely showed this finding.

The authors suggest that this method of examination be used routinely to study and follow the progress of diseased hearts.

Seven roentgenograms; 3 charts.
LAWRENCE E. FETTERMAN, M.D.
Cleveland City Hospital

Demonstration of Subepicardial Fat as an Aid in the Diagnosis of Pericardial Effusion or Thickening. Daniel J. Torrance. *Am. J. Roentgenol.* 74: 850-855, November 1955.

In nearly all hearts there are well developed deposits of fat beneath the epicardium, principally along the distribution of the coronary arteries. It is believed that roentgenographic demonstration of this subepicardial fat would aid materially in the diagnosis of pericardial effusion or thickening. The fact that films do not usually show a subepicardial fat line in cases of pericardial effusion may have several explanations—cardiac motion during exposure, blurring-out of the faint fat shadow due to scatter, and alteration in the roentgenographic density of the fat as a result of infiltration with edema fluid secondary to inflammatory pericarditis.

The ideal roentgenographic tool would be a laminogram of the heart shadow taken at 1/60 of a second or a regular high-kilovoltage cone-down view of the heart exposed at 1/120 of a second to "stop" heart motion. The author has used a regular "heavy" laminographic technic. While there is considerable normal variation in the distribution of cardiac fat, the most strategic fat area for purposes of roentgenographic demonstration is that associated with the left anterior descending coronary artery. This area is thrown into profile when the patient is in the right anterior oblique or left posterior oblique position with reference to the table top. Centering is in the region of the cardiac apex, previously determined with the help of a regular chest roentgenogram.

Nine roentgenograms beautifully demonstrate the decreased line of density produced by fat between the heart and pericardium. WYNTON H. CARROLL, M.D.
Shreveport, La.

Coarctation of the Aorta with Patent Ductus Arteriosus. William B. Seaman and David Goldring. *J. Pediat.* 47: 588-598, November 1955.

Coarctation of the aorta in infancy is not rare, 21 cases having been seen at the St. Louis Children's Hospital from 1938 to 1949. The authors have collected 12 examples (including 3 cases previously reported by Calodney and Carson. *J. Pediat.* 37: 46, 1950) of aortic coarctation associated with patent ductus arteriosus that have been studied roentgenographically, with establishment of the diagnosis either by surgical exploration or at autopsy. In 5 cases angiocardiology was performed.

A review of the conventional roentgenograms of 12 autopsied cases revealed moderate to marked cardiac enlargement in all. In most instances, the elevated rounded apex of the cardiac silhouette in the frontal projection and the anterior prominence of the heart in the oblique and lateral views strongly suggested right ventricular enlargement. All of the cases showed definite enlargement of the pulmonary vascular shadows indicative of increased blood flow and/or pressure in

the pulmonary circulation. These findings contrast sharply with the clear lungs and left ventricular hypertrophy seen in uncomplicated cases of coarctation of the aorta. Marks and associates (J. Pediat. 43: 453, 1953. Abst. in Radiology 63: 284, 1954) described the findings in a two-day-old infant with coarctation and a patent ductus correctly diagnosed during life by roentgen evidence of pulmonary vascular congestion and an indentation in the lateral margin of the descending aorta. In most of the authors' cases the shadow of the aortic arch could not be identified on the conventional films. The presence of pulmonary vascular engorgement does not necessarily indicate a right-to-left shunt, since it also occurs when the patent ductus is proximal to the coarctation and the shunt is from left to right.

Angiocardiography is the most accurate method of differential diagnosis, but in the authors' opinion should be employed only if the diagnosis is not firmly established clinically. Four cases are presented in which angiocardiography was performed; in 2 death occurred immediately. Both infants were cyanotic, with a coarctation proximal to a patent ductus allowing a right-to-left shunt.

The pathologic anatomy and physiology must be kept in mind in selecting the route of injection of the contrast material. When the coarcted segment lies distal to the patent ductus, a retrograde injection will demonstrate the narrowed aortic segment and the opacification of the pulmonary arterial system will indicate the presence of a patent ductus. When the coarctation lies proximal to the patent ductus, however, the pressure gradient may not permit flow from the aorta into the pulmonary artery and thus no evidence of patent ductus will be obtained. In this instance, the intravenous route is the method of choice, and the flow of contrast material from the pulmonary artery to the descending aorta may be observed.

The diagnosis of coarctation of the aorta in infancy may be quite difficult because the critical status of the patient does not permit complete examination. The authors have found the flush technic of blood pressure determination and blood oxygen studies helpful.

The prognosis for most infants with coarctation is poor. The opinion that most cases can be managed medically and operated upon at a later age has not been supported by the authors' experience. Sixteen of their patients were treated medically and died, 5 during an attempt at surgical correction.

Eleven roentgenograms.

Double Aortic Arch. K. R. Doraiswami. Indian J. Radiol. 9: 226-232, November 1955.

A case of double aortic arch with a dominant left arch and right descending aorta is presented. The patient was a 65-year-old male with a history of frequent respiratory infections. Radiologically, the descending aorta was seen to the right of the spine. The esophagogram showed a shallow anterior impression and a smaller sharp posterior defect, representing the retro-esophageal portion of the left arch joining the right arch to form the descending aorta.

The author discusses the importance of a precise diagnosis of double aortic arch, as the surgical approach differs according to the variant. The four variants are: (1) double aortic arch with a larger right arch and left descending aorta; (2) double aortic arch with a larger left arch and right descending aorta; (3) left aortic arch with a right descending aorta; (4) right aortic arch

and right descending aorta with a left ligamentum arteriosum.

The embryologic background of the condition is discussed.

Seven roentgenograms.

ALEXANDER R. MARGULIS, M.D.
University of Minnesota

Occlusion Patterns and Collaterals in Arteriosclerosis of the Lower Aorta and Iliac Arteries. Edward A. Edwards and Marjorie LeMay. Surgery 38: 950-963, November 1955.

The authors studied 37 aortograms showing arteriosclerotic occlusion of the lower aorta or iliac arteries in an attempt to determine the pattern of occlusion and the identity of the collaterals. Considering those films which were obtained following injection at an adequately high level, the inferior mesenteric artery failed to fill in 37 per cent, the internal spermatic or ovarian in 76 per cent (on one or both sides), and the hypogastric in 29 per cent (on one or both sides). As an ancillary study, stereoscopic roentgenography and dissection were carried out on cadavers whose arterial systems had been injected with an opaque medium, as an aid in identifying the branches of the hypogastric artery in the living.

Obstruction at the aortic level, which occurred in 6 cases, tended to be more localized when it began at either the common or external iliac level. The major collaterals for the aortic obstructions centered about the rectum and iliac crest. The inferior mesenteric or the anastomosis from mid- to left colic were the main affluents for the first pathway, the lumbar arteries for the second. The role of the internal mammary-inferior epigastric pathway is uncertain. Some of the authors' cases showed filling of the inferior epigastric, indicating that the artery was not being used as a collateral.

The common iliac obstructions, of which there were 23, tended to reveal diffuse arteriosclerosis with frequent concomitant occlusion of the external iliac, hypogastric, and femoral systems. The collaterals in 2 instances of bilateral common iliac occlusion were similar to those of the aortic cases. In the unilateral closures, the pathways, in order of importance, were: iliac, sacral, transverse, and rectal. The latter were not used except in extremely diffuse disease.

Occlusion of the external iliac often included the common femoral artery. The collaterals were almost always between the descending branches of the hypogastric artery, leading to the femoral circumflex and the profunda femoris arteries. The iliac pathway was used only when the terminal part of the external iliac was patent. Concomitant obstruction of the common and external iliacs, which was quite common, brought into additional play rectal, iliac, sacral, and transverse anastomoses.

The occurrence of gangrene could not be related to the height of the obstruction but was somewhat dependent upon closure of vessels usually used as collaterals, and even more upon obstruction of the distributing femoral system of arteries.

It is suggested that in the arteriosclerotic patient obstruction of the inferior mesenteric artery may be responsible for digestive disturbances, obstruction of the sex arteries for diminution in function of the testes or ovaries, and obstruction of the hypogastric artery for neuritis of the lumbosacral plexus.

The anastomoses between the arteries of the various collateral pathways were generally retiform and small. Only the obturator-medial femoral circumflex connection exemplified a bold inosculation with any frequency. The small size of the anastomotic connections correlates with the reduced blood flow which these anastomoses are known to supply.

Since a single collateral pathway is often responsible for the nutrition of the lower limb or limbs, it appears possible for division of one collateral artery to precipitate gangrene.

Eight roentgenograms, with accompanying drawings; 2 tables.

Spontaneous Carotid Thrombosis. Unusual Arteriographic Appearance. Burton L. Wise and Jacob J. Foster. *Neurology* 5: 821-824, November 1955.

A 52-year-old white male gave a history of sudden onset of severe pain behind the right eye, progressive confusion, and weakening in the left lower extremity. These symptoms were immediately superseded by stupor and a left spastic hemiparesis, and eventually by deep coma. Percutaneous right carotid angiography demonstrated a radiolucent shadow within the internal carotid, reaching down to the bifurcation of the common carotid and into the external carotid. The opaque medium could be seen on either side of the long intraluminal filling defect. A right common carotid angiogram by cut-down technic was immediately obtained and a complete occlusion of the common carotid artery just beneath its bifurcation was demonstrated. The right common, internal, and external carotid arteries were then exposed surgically. A firm, dark thrombus adherent to the carotid bulb was apparent, with a tail-like propagation into the internal carotid artery. This extension had no attachment to the walls of the internal carotid artery and was evidently floating free within its lumen. Some projection of the thrombus was also present in the external carotid artery. A thrombectomy was without benefit, and the patient died approximately three days later. At autopsy, thrombus was found throughout the intracranial course of the right internal carotid artery and in its right anterior and middle cerebral arterial divisions.

Presumably, the pressure of the injection for the percutaneous angiogram was sufficient to force the opaque medium between the intima and thrombus and thus outline the thrombus as a linear radiolucent filling defect. When the cut-down procedure was performed, the injection was made lower, and no opaque medium passed beyond the point where the thrombus was adherent to the common carotid wall.

The authors reason, on the basis of this case, that a carotid thrombus arises from a localized area, to which it becomes affixed. From this point it extends distally. The tail-like extension may not be attached initially, but then becomes loosely adherent and eventually fixed to the walls of the recipient vessel. Prior to fixation, thrombectomy may be sufficient to preclude intracranial extension of a carotid artery thrombus. Subsequently, after firm intimal attachment is present, thromboendarterectomy is necessary, but even this may be unsuccessful in re-establishing the continuity of the artery.

Three roentgenograms; 2 photographs.

JOHN W. WILSON, M.D.
University of Texas, Dallas

Multiple Large Aneurysms of the Splenic Artery. A Case Report with Aortographic Confirmation and Operative Proof. Paul A. Riemenschneider. *Am. J. Roentgenol.* 74: 872-873, November 1955.

A 61-year-old female was admitted to the hospital following an automobile accident. Roentgenograms of the lumbar spine revealed fractures of the bodies of the third and fourth lumbar vertebrae. High in the left upper quadrant were six calcified ring-like shadows measuring up to 4 cm. in diameter, diagnosed as multiple aneurysms of the splenic artery. An aortogram demonstrated complete opacification of the most proximal aneurysm. Because of the mortality associated with rupture of these aneurysms, a prophylactic splenectomy was done six months later. Recovery was essentially normal.

Four roentgenograms; 1 photograph.

WYNTON H. CARROLL, M.D.
Shreveport, La.

Costophrenic Septal Lines in Pulmonary Venous Hypertension. André J. Bruwer, F. Henry Ellis, Jr., and John W. Kirklin. *Circulation* 12: 807-812, November 1955.

One hundred and fifty-two cases of mitral stenosis subjected to commissurotomy were studied for costophrenic septal lines (linear x-ray shadows, B lines of Kerley). They were found in a third of the series but seemed to be correlated with pulmonary hypertension involving the venous and arterial beds rather than the arterial alone. In a group of patients with conditions other than mitral stenosis, the lines were found in only 3, with calcific aortic stenosis with evidence of cardiac failure and elevated pulmonary venous pressures.

Twenty cases were followed after surgery, and in 9 the lines disappeared. In all of these the surgical results were excellent. Among the 11 in which the lines persisted, there were excellent results in 7, but 2 patients died and 2 others were regarded as failures.

It would seem that disappearance of the lines following surgery is definitely favorable prognostically but their persistence is not necessarily a bad sign. The authors believe that the permanent lines may be associated with hemosiderosis; the transient ones with edema from lymphatic back pressure.

Five roentgenograms; 4 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Congenital Dystrophic Angiectasis. H. D. de Reus and M. Vink. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 83: 690-702, November 1955. (In German)

It is recalled that in 1900 Klippel and Trenaunay identified a rare syndrome as "varicose osteohypertrophic naevus." Eighteen years later, Parkes Weber distinguished in a group of "haemangiectatic hypertrophies of the limbs" a condition characterized by combined arterial and venous ectasia, such as had previously been described by German writers as "phlebarteriectasis." Still later he used the term "congenital varicose veins" in connection with the syndrome of Klippel and Trenaunay. In America similar entities have been called "congenital arteriovenous fistulas."

Twenty-nine cases of this type were found by the authors in the Dutch literature, to which they add 2 further examples. They suggest the name "congenital dystrophic angiectasis" for a complex clinical picture which includes *vascular dystrophies* (angiomata, phlebec-

tasias, arteriectasia, anomalous arteriovenous communications) and *osseous dystrophies* (hyperplasia, hypoplasia, structural changes). Any combination of these alterations can be encountered in practice, which explains the differing terminology proposed (as the "congenital osteodystrophic angiectasis" of Cousin or the "dystrophic angiomatosis" of Holthuis). The pathogenesis of this kaleidoscopic condition is obscure.

The importance of detailed angiographic study for the evaluation of any particular case is stressed. In the first of the 2 cases reported serial aorto-arteriophlebography (30 c.c. of 70 per cent organic iodine compound injected into the aorta at the level of L-3) established the existence of extensive arteriovenous communications throughout the right lower extremity and the right side of the pelvis. Surgical ligation of some of these communicating channels resulted in local improvement. The second patient had a congenital angiomatous nevus on the right leg, with extensive varicosities. There were no arteriovenous communications, but a phlebogram demonstrated an obstruction in the popliteal vein, confirmed and corrected at surgery.

Twelve roentgenograms; 3 photograpsis.

E. R. N. GRIGG, M.D.
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THE DIGESTIVE SYSTEM

Peptic Esophagitis, Peptic Ulcer of the Esophagus and Marginal Esophagogastric Ulceration. Bernard S. Wolf, Richard H. Marshak, Max L. Som, and Asher Winkelstein. *Gastroenterology* 29: 744-766, November 1955.

Inflammatory and ulcerative lesions of the lower esophagus have usually been divided into two groups: (1) reflux or peptic esophagitis and (2) peptic ulcer of the esophagus. Peptic esophagitis, the most common non-specific inflammatory condition of the esophagus, is of two main varieties: (a) cases following intubation or operation, or occasionally persistent vomiting, especially in association with duodenal ulcer, in the absence of any pre-existing abnormality at the esophagogastric junction; (b) cases associated with obvious hiatus hernia of the sliding or rolling type. The second group comprises ulceration occurring in a gastric-lined esophagus. The authors add a third group, "marginal esophagogastric ulceration," occurring as a discrete lesion in a junctional or terminal segment present in the lowermost portion of the esophagus. Gastric rugae are seen at the distal margin of the ulceration and marked obstruction occurs at this site; regurgitation is free through a patulous though narrowed channel; a narrowing is seen proximal to the ulceration, apparently spastic in nature. A fourth group of cases occurs following surgery, at the margin of an esophagogastric anastomosis or gastrojejunostomy, but is not considered here.

The roentgen findings in peptic esophagitis of the "tube" type consist of marked narrowing of a long straightened segment of the lower esophagus, with serrated and indistinct contours. Above, there may be an area of moderate dilatation, joining the narrowed segment with abrupt tapering. The mucosal pattern in this segment is quite irregular. No ulcer niche is present. In peptic esophagitis associated with sliding hernia, roentgen findings are usually indefinite. It is generally impossible to visualize the esophagus as a whole with barium. Occasionally a distorted, irregular

surface pattern and contour may be demonstrated. Late in peptic esophagitis, strictures may be seen. In general, ulcerations occurring in squamous epithelium are rarely deep, and "niches" are seldom visualized.

Peptic ulcer of the esophagus is observed in elderly individuals. Exact delineation of the pathological and anatomical features roentgenologically is usually difficult. However, the diagnosis may be suspected if an ulcer is demonstrated which is unusually high, deep, or elongated. Marked stricture as a result of such an ulcer is said to be rare.

In the third or marginal esophagogastric type of ulceration, if it is non-stenotic, a localized patch of barium may be recognized within a short, incompletely distensible segment. If the lesion is of the stenotic variety, the characteristic finding is a short segment of narrowing with tapering esophagus above and tapering triangular hernial sac below, the so-called "bow-tie" appearance. The hernial sac shows longitudinal gastric rugae and there is usually no pouching along its greater curvature.

Peptic esophagitis in association with a sliding hernia, in the absence of duodenal ulcer, rarely goes on to stricture formation. In patients with duodenal ulcer and hiatal hernia a severe esophagitis with stricture formation may develop. The peptic esophagitis occurring after intubation or vomiting has a relatively good prognosis, with periodic dilatation and medical therapy. In marginal esophagogastric ulceration the outlook is poor, with frequent recurrence and often severe stricture.

Forty-two roentgenograms; 2 photographs; 2 diagrams.

JOHN F. RIESSER, M.D.
Springfield, Ohio

The Acute Abdomen. I. The Value and Limitations of Radiology in Acute Abdominal Conditions. J. Frimann-Dahl. *Brit. J. Radiol.* 28: 581-586, November 1955.

Opening a Symposium on the "acute abdomen," the author discusses the radiologic aspects, emphasizing the importance of correlating the clinical and radiographic findings.

The greatest contribution of radiology is in acute intestinal obstruction or ileus. In 445 cases of small bowel obstruction the diagnostic error was only 5 per cent. This high degree of accuracy the author attributes to the use of barium orally in all dubious cases. The radiographic findings indicate not only the presence of obstruction but its approximate site.

The picture ranges from a single small fluid level with a tumor-like density within the abdomen to the typical Rigler's coffee-bean sign, depending upon the mechanism of obstruction. The lack of signs in some acute, complete strangulating obstructions is due to accumulation within the strangulated loop of sanguineous fluid and very little gas. A partially strangulated loop, on the other hand, may be distended by gas, as time progresses, to form the typical coffee-bean configuration. If such a loop remains fixed despite various positional changes, the diagnostic reliability of the sign is increased. In every case of obstruction, an attempt is made to determine the occluding mechanism. In some instances, the findings are typical, while in others the signs may be confused with strangulation in a part of the intestine not actually involved in the process. In such instances, the barium enema and barium swallow are of particular help.

In the postoperative period, the diagnosis of obstruction or ileus is often doubtful. Repeated radiologic examinations are of particular importance to demonstrate the course and progression of the bowel pattern. Contrast studies may be of value in ascertaining the nature of the process.

In gallstone ileus, there are three cardinal signs: gas in the biliary tree, evidence of obstruction, and a large stone located somewhere within the abdomen. For localization of a non-opaque calculus, contrast studies may be required. The real danger in gallstone ileus is prolongation of the observation period, thus jeopardizing the patient's ability to withstand the necessary operative procedure.

Obstruction of the large bowel is comparatively easily detected. A barium enema is of confirmatory value.

Thirteen roentgenograms. R. B. CONNOR, M.D.
University of Texas, Dallas

The Acute Abdomen. II. Radiological Help in the Diagnosis of Abdominal Emergencies. Rodney Smith. Brit. J. Radiol. 28: 586-589, November 1955.

From the surgeon's point of view the author considers (1) the indications for asking for radiological help in an abdominal emergency and (2) the scope of x-rays in individual cases.

Under the first heading four guiding principles for the surgeon are offered: (1) think of x-rays in the admitting department; (2) do not waste time if the diagnosis is already clear; (3) always ask for radiologic help if there is doubt about the necessity or urgency of surgery; (4) never omit x-ray studies if some non-operative plan of treatment is intended.

In acute perforations and acute intraperitoneal hemorrhages, the usefulness of roentgen evidence is not great. In acute intestinal obstruction of all varieties, however, x-ray examination of the abdomen is of maximal value. In acute simple occlusion of the small bowel there is absence of gas from the large bowel and a rough guide to the level of the obstruction is furnished by the number and distribution of gas-dilated coils and fluid levels. The precise cause of the occlusion is seldom demonstrable radiologically, though gallstone ileus may be suggested by gas shadows in the biliary tree or even an outline of the obstructing stone itself.

In acute occlusions of the large bowel, the localization of the point of involvement is more accurate. Plain films are usually adequate but contrast studies may be useful.

Strangulation of the bowel is most frequently due to an external hernia, in which event no diagnostic problem is encountered. An internal hernia may be another question. A radiographic feature suggesting this possibility is a dilated coil of bowel unaltered on serial and positional films. Strangulation of the large bowel is confined principally to volvulus of the pelvic colon. In these instances plain films are usually diagnostic.

In a paralytic ileus there is abnormal dilatation of both large and small bowel, a finding that is helpful in differentiating this cause of abdominal distention from organic obstruction. Progress films are all-important under these circumstances.

Severe and overwhelming peritonitis may be associated with a paralytic ileus but edema and adhesions may produce an organic obstruction as well. The diagnostic features are evidence of obstruction, abnormal width of the bowel wall due to separation by an inflam-

matory exudate, and extraluminal fluid within the abdominal cavity.

In postoperative obstructions, which may be due to any one of the foregoing causes, the more promptly the correct diagnosis is established, the greater the likelihood of a good recovery. Under these conditions radiologic consultation is of the greatest aid and value.

R. B. CONNOR, M.D.
University of Texas, Dallas

The Acute Abdomen. III. Plain Radiography of the Abdomen in Paediatric Practice. Nicholas Hajdu. Brit. J. Radiol. 28: 590-604, November 1955.

Part I. The Neonatal Period: The author discusses benefits from studying the plain roentgenograms of the abdomen in children, pointing out that the main source of contrast is provided by air swallowed during feeding and crying. Swallowed air appears in the stomach five to seven minutes following birth, in the jejunum in one hour, and in the ileum in two hours, in the proximal colon in three hours, and the rectosigmoid in four to eight hours. At twelve hours the entire intestine should be clearly visible by virtue of its gas content and should fill the whole space available in the abdominal cavity. Any departure from this rule will raise the suspicion of intestinal obstruction on the one hand and of a space-occupying lesion on the other.

Intestinal obstructions presenting in the first few days of life are mostly due to developmental errors and fall into five groups: (1) failure of recanalization; (2) failure of mucocutaneous fusion; (3) errors of rotation; (4) failure of secretion; (5) failure of nerve supply. The incidence of these conditions as reported in the literature varies widely, but an average acceptable figure is approximately 1:1,000 live births. Of the obstructions, atresia and stenosis comprise something over a third, with imperforate anus contributing approximately a fourth and malrotation and volvulus a little less than one-fifth. Meconium ileus, neonatal Hirschsprung's disease, strangulation due to hernia, and miscellaneous conditions comprise the rest of the group.

In errors of recanalization, atresia of the esophagus associated with a fistula between the trachea and lower esophageal segment is the most common. This is manifested roentgenologically by an abnormally rapid increase of gas in the intestine during the first few hours of life, as a result of air forced into the alimentary tract through the fistula.

In congenital duodenal obstruction the characteristic roentgen sign has been said to be gas in the upper abdomen, forming two distinct loculi, one in the stomach and one in the proximal duodenum. This sign, however, is valid only in cases of complete or nearly complete obstruction. A barium meal may be conclusive where plain radiography fails. It may be difficult to distinguish between an intrinsic and extrinsic duodenal obstruction. If complete atresia is present, the chances are 5 to 1 that the obstruction is intrinsic; if atresia is incomplete, the chances are about equal for an intrinsic or extrinsic lesion. In the second part of the duodenum an obstructing membrane or blind end is more common; in the third part pressure by intrinsic bands plays the most important role. If the cecum can be shown to lie in the mid-line, the diagnosis of extrinsic compression of the duodenum is practically certain.

Jejunal atresia is indicated by the demonstration of a single distended loop of small intestine across the

upper abdomen. Multiple atresias are present in 15 to 18 per cent of cases and as a rule cannot be distinguished from a single atretic segment. The number of gas-distended loops may well give some indication as to how low in the intestine the obstruction is situated.

Failure of fusion of the hind-gut with the proctodaeum gives rise to various forms of imperforate anus. Usually the maneuver devised by Wangenstein and Rice (Ann. Surg. 92: 77, 1930. Abst. in Radiology 15: 716, 1930) will demonstrate the distance between the anal dimple and the blind end of the rectum.

Errors of rotation of the mid-gut loop interfering with secondary fixation of the mesentery may result in a number of abnormal intestinal attachments but characteristically do not cause difficulty until days or weeks after birth. These conditions indicate another necessity of early films of the abdomen, inasmuch as the progress of gas through the intestinal tract within the first twelve hours of life could suggest the possibility of malrotation, thereby forewarning the clinician of the error before the occurrence of actual volvulus or acute obstruction.

Meconium ileus occurs in approximately 20 per cent of cases of cystic fibrosis of the pancreas and is frequently accompanied by atresia of the ileum and other complications, which dominate the roentgen picture. In the absence of complications, there is distention of the small intestine, tapering toward a point of obstruction, with small bubbles of gas in the viscid meconium.

In Hirschsprung's disease the x-ray findings vary according to the severity of the obstruction. In approximately 10 per cent of the cases there is a long aganglionic segment presenting an x-ray appearance similar to atresia of the ileum or proximal colon or resembling meconium ileus. In other cases, the appearance is that of mechanical large bowel obstruction. Contrast material may be employed to identify shorter aganglionic segments.

The typical x-ray signs of meconium peritonitis are intraperitoneal calcification related to the extruded meconium, associated with signs of intestinal obstruction and free intraperitoneal fluid.

Duplications of the stomach or intestine do not contain gas and are diagnosed only if they are large enough to displace adjacent gas-filled loops. Duplication of the esophagus presents as a spherical mass in the posterior mediastinum. These cystic lesions show intermittent variation in size and produce occult bleeding into the lumen of the associated gut.

The diagnosis of diaphragmatic defects is not a difficult radiologic problem.

In considering neonatal obstructions as a whole, it may be said that the complications of microcolon, perforation, meconium peritonitis, ascites, bands, kinks and volvulus may occur with any of the primary lesions mentioned. In all of these a plain radiograph of the abdomen will indicate the necessity of immediate surgical relief. The high surgical mortality associated with these conditions may be reduced by employing early x-ray procedures. The use of portable apparatus in the nursery is suggested for screening purposes.

Part II. The Post-Neonatal Period: During the weeks following the neonatal period, hypertrophic pyloric stenosis is the most frequently encountered obstruction. The peak incidence is in the sixth week and the condition ceases to exist in the clinically recognizable form after the sixth month. Plain films fail to reveal the lesion in the majority of the cases.

Intussusception is regarded as the most important abdominal emergency of infancy and childhood, with the incidence reaching a peak about the middle of the first year. Here the plain roentgenogram is of immeasurable value. It often reveals a soft-tissue mass in contrast with the gas-filled small intestine and residual gas in the large bowel. The number of distended loops of small bowel varies according to the time of onset as related to the time of examination, but the overall picture is that of low small intestinal obstruction. Preservation of the gas pattern throughout the entire intestine excludes intussusception.

Other conditions seen in infancy include fecal impaction, foreign bodies, abdominal tumors, inflammatory conditions (renal and enteric), and hematoocolpos. Changes in the bowel pattern associated with any of these conditions may simulate other types of bowel obstruction and the diagnosis may be extremely difficult to establish radiographically. Under these conditions, serial studies may be of importance. Ascites and intra- and retroperitoneal tumors offer little difficulty in differential diagnosis. One finding of interest is a localized ileus associated with an intraperitoneal inflammation. The author believes this results from reduced intestinal tone secondary to inflammation of the intestinal smooth muscle. This sign was never found in conjunction with an extraperitoneal abscess.

Forty-five roentgenograms. R. B. CONNOR, M.D.
University of Texas, Dallas

The Value of Emergency Radiology in Acute Bleeding of the Upper Gastrointestinal Tract: A New Approach to the Problem. Elias Kredi Dabaj, Denio Odoardo Fonseca, Francisco Conde Otero, Joaquin Torres Cruz, and Rolando Pereira Costa. Arch. del Hospital Universitario 7: 1-45, May-June 1955. (In Spanish)

The authors describe their experiences with the emergency radiologic study of 24 patients with acute bleeding of the upper gastrointestinal tract. The technic of examination is essentially as follows: After preliminary laboratory work and administration of the required number of transfusions to bring the patient completely from shock, he is taken to the x-ray department, where a complete gastrointestinal study is made, including upright and supine views, compression and spot films. The actual examination differs in no way from a competently done routine study. The patient must not be removed from the x-ray table until every possible means has been used to arrive at a diagnosis. The essential pillar of the method is generous blood transfusions as a prophylactic measure.

This technic caused no complications in any of the 24 patients studied, and 87.5 per cent of the number left the x-ray department with a pathologic diagnosis. Further, the actual ulcer crater was observed in 14 of the 18 gastroduodenal ulcer patients investigated, furnishing evidence against the concept that the crater is not seen in bleeding ulcers because of a protecting clot. In 4 cases it was not possible to reach a definite diagnosis, but in 2 of these the technic was deficient.

The pathologic diagnosis was established by operation, autopsy, endoscopy, and subsequent clinical course in 83 per cent of the patients. The roentgenologic diagnosis was proved correct in 88 per cent.

Eighteen roentgenograms; 4 photographs.

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Gaseous Inflation of the Gastrointestinal Tract. Milton M. Lieberthal and H. David Frank. New England J. Med. 253: 901-904, Nov. 24, 1955.

The authors point out that the accumulation of gas within the gastrointestinal tract represents the difference at any given moment between gas-forming and gas-removing mechanisms. Other than artificial means, there are three possibilities by which gas accumulates in the gastrointestinal tract. The chief of these is ingestion, which accounts for some 70 per cent of gas, even in cases of intestinal obstruction. This gas, if not eructated, may reach the cecum in six to fifteen minutes and be passed as flatus within thirty minutes. Even in cases of small bowel obstruction, putrefaction accounts for no more than 10 per cent of the gas, and for this small amount a concomitant impairment of intestinal circulation is necessary. A third factor contributing to the presence of gas in the bowel is diffusion from the blood stream into the stomach or intestinal lumen. This may account for 20 per cent of the visualized gas above a point of intestinal obstruction, but is still secondary in importance to the ingestion of air.

Normally the ingested and other gas in the tract is removed by ejection *via* mouth or anus, by diffusion into the blood stream and by absorption through the intestinal wall.

Two cases are presented, as additions to the 6 well documented cases appearing in the literature, showing the gastrointestinal tract outlined by ingested gas in the absence of significant organic disease. Aerophagia is much more common in nervous individuals. The final diagnoses in the authors' cases were psycho-neurosis with severe aerophagia and anxiety neurosis with the aspiration of large amounts of air.

Eight roentgenograms. SAUL SCHEFF, M.D.
Boston, Mass.

Sarcoma of the Stomach. Analysis of 17 Cases. Seymour Ochsner and Alton Ochsner. Ann. Surg. 142: 804-809, November 1955.

An analysis of 17 cases of sarcoma of the stomach encountered at the Ochsner Clinic between 1942 and 1954 is presented. These accounted for 5.7 per cent of the malignant gastric neoplasms. Ten were varieties of lymphoma, 6 were leiomyosarcomas, and 1 was a neurofibrosarcoma. The average age of the patients was fifty-seven years, similar to that of carcinoma of the stomach (contrary to many other reports, which indicate that sarcomas occur in a younger age group). Thirteen of the patients were males.

Clinically, there are no symptoms of gastric sarcoma which suggest a specific diagnosis. The leiomyosarcomas showed a definite propensity toward hemorrhage, whereas the lymphomas did not. This is explained by the high incidence of ulceration in the former. Abdominal pain, tenderness, anemia (in leiomyosarcoma), indigestion, and weight loss were noteworthy signs and symptoms.

Radiographically, a diagnosis of gastric neoplasm was made in all but 1 case. In this instance, retrospective examination of the roentgenograms revealed the polypoid lesion in the fundus. The most common radiologic sign was an intraluminal filling defect. The filling defect was usually regular in leiomyosarcomas and irregular in lymphomas. Ten of the 17 cases showed ulcerations. Interruption of the mucosa was noted in only 4 cases, all in patients with lymphomas. Loss of

flexibility and circumferential narrowing of a portion of the stomach were present in 3 cases. In 1 instance, demonstration of generalized enlargement of the gastric rugae with normal flexibility, and without ulceration or tumor formation, led to a correct roentgenologic diagnosis of sarcoma.

Gastric resection was performed in 4 of the patients with lymphoma and 1 (with Hodgkin's disease of the antral portion) survived more than six months. Four of the lymphomas were considered inoperable, and in 2 of this number roentgen therapy was followed by survival for eighteen months. Exploration was performed in all 6 patients with leiomyosarcoma; resection was possible in 5, with an average survival approaching five years. The one neurofibrosarcoma was completely removed, but no follow-up study was available.

In the general treatment policy, exploration and biopsy are indicated in all patients with a presumptive diagnosis of gastric neoplasm. If a leiomyosarcoma is encountered, extensive surgical excision is warranted. If the lesion proves to be a lymphoma, it can be treated by irradiation as well as excision, but the authors express the opinion that excision should be performed if feasible. In any event, postoperative roentgen therapy is recommended in the lymphoma group. This recommendation is based upon the radiosensitivity of lymphomas as a group plus a high incidence of regional node involvement (40 per cent) in surgical cases of gastric lymphoma.

Three roentgenograms; 3 tables.

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Gastric Malignant Lymphoma: Increasing Accuracy in Diagnosis. Melvin I. Klayman, Joseph B. Kirsner, and Walter L. Palmer. Gastroenterology 29: 536-547, October 1955.

The authors present their experiences in the management of 7 cases of malignant lymphoma of the stomach during an eighteen-month period. In only 2 patients was the diagnosis suspected initially: in 1 because of a previous lymph node biopsy and in the other because of the unusual roentgenographic appearance of the stomach.

Six of the patients were studied by combined roentgenography, gastroscopy, and exfoliative cytology. The seventh patient underwent exploratory surgery following demonstration of an extra-gastrointestinal tract lesion radiographically.

Roentgen examination detected gastric lesions in 4 (of the 6). In 1 the diagnosis was neoplasm; in 2, benign ulcer; in 1, probable malignant lymphoma. The gastroscopic examination also revealed 4 lesions but each of the methods detected a lesion missed by the other on one occasion. Exfoliative cytology correctly identified the cellular nature of the lesion in 4 patients, and failed in 2.

Four roentgenograms; 6 photographs and photomicrographs.
DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Benign Tumors of the Stomach and Duodenum. Their Radiologic Appearance. Robert N. Cooley and Vernie A. Stembbridge. Texas State J. Med. 51: 754-764, November 1955.

The authors report on 71 cases of benign tumor of the stomach and 9 of benign duodenal tumor recorded in

the Department of Pathology of The University of Texas Medical Branch Hospitals, 1893-1954. A large proportion of benign tumors of the stomach are found incidentally at autopsy. In the present series there were 57 benign stomach tumors among 9,870 autopsies. In the combined autopsy and surgical material there were 71 benign tumors among 495 gastric neoplasms of all kinds, an incidence of 14.3 per cent. If, however, only those growths that were of clinical or radiologic significance are considered, the incidence is only 3.0 per cent of all stomach tumors.

Adenomatous polyps of the stomach accounted for 35 cases in this series; 10 were multiple and 25 single polyps. In only 2 cases were there symptoms that could be attributed to a single polyp, and in 1 of these some relief followed removal of a large polyp from the pylorus. Only 1 of the single polyps was found to be associated with a malignant tumor. One of the cases of multiple polyps was associated with a long-standing pernicious anemia with achlorhydria. In 2 other cases there was a definite anemia of the hypochromic type.

Gastric polyps are described as radiolucent shadows within surrounding barium. Their contour is usually rounded or oval; in the larger tumors it may be lobulated. Obstruction is not common. The value of good mucosal study films is stressed.

Leiomyomas are second to adenomatous polyps in frequency. Of a total of 20 cases, 18 were apparently asymptomatic or at least undetected until they were found at autopsy. In 15 cases the tumors did not exceed 1 cm. in diameter.

Calcium is frequently deposited in gastric leiomyomas and occasionally may be sufficient in amount to be detected by radiologic means. Leiomyomas typically originate within the wall of the stomach. Consequently, the small and medium-sized tumors elevate the mucosa and have a smooth rounded semicircular or semi-elliptical appearance. With pressure films, mucosal folds may be seen to extend to the margins of the tumor. The large leiomyomas may ulcerate. The ulcer crater may be deep and at times consists of deep pockets or crevices leading into the depths of a partially necrotic tumor. Barium may enter these crevices and extend to such a distance that extravasation or leakage outside of the stomach is suspected.

No benign tumors of neurogenic origin were found in this series, which is in general agreement with other studies, though neurofibromas and schwannomas may occur. These tumors have no distinguishing characteristics which would permit a differentiation from other benign tumors by radiologic means.

Five tumors were classified as *fibromas*, 2 as *fibromyomas*, and 1 as *myofibroma*. None of these were apparently of any clinical significance; the largest was less than 2 cm. in diameter. The tumors are typically round or slightly lobulated, and pedunculation is common.

Lipomas comprise only a small portion of benign neoplasms of the stomach. In this series 3 were found, 2 of which were clinically significant. The form is typically spherical or ovoid and the position submucosal. Pedunculation is rare. Their extreme radiolucency may serve to distinguish these tumors from other benign neoplasms of the stomach, but differentiation from leiomyoma may be difficult.

In this series there was only 1 case of *aberrant pancreatic tissue*, and this was an incidental finding at autopsy. This is far more common in the antrum than

elsewhere within the stomach. The tumor appears as a rounded or oval, rather smooth filling defect within the stomach wall. Rarely, it may be pedunculated or polypoid. The overlying mucosa is smooth, but normal gastric mucosa can be followed to the usually sharp margin of the tumor. There is no interference with peristalsis or mobility of the stomach wall. In many instances, a significant feature is the presence of a pit or depression over the mid portion of the mucosal surface. When this depression fills with barium, it produces a fleck which lies near the center of the tumor, constituting a distinctive sign which is suggestive of an aberrant pancreatic adenoma.

Vascular tumors of the stomach are rare, their incidence having been placed at about 0.09 per cent of benign gastric growths. One example—a lymphatic cyst—was encountered in the present series. Hemangiomas are said to be found occasionally in widespread multiple hemangiomatosis and multiple hemorrhagic telangiectasia. These lesions have no distinctive radiologic appearance.

In addition to the tumors discussed above there were found 1 *myxoma*, 1 *submucous cystic tumor*, and 1 diagnosed simply as a benign gastric tumor. *Other rare tumors* include glomus tumor, osteoma, osteochondroma, pheochromocytoma, histiocytoma, and benign reticulum-cell tumors. Eosinophilic granulomas have been reported. These conditions would simulate multiple polyposis, inflammatory fibroid polyps, polypoid gastritis, and mucosal hypertrophy of the stomach.

Of the 9 duodenal tumors in this series, 8 were incidental autopsy findings. The largest of these was 2 cm. in diameter. The remainder of the incidental tumors were less than 1 cm. in diameter. In 2 cases they were multiple. All except 1 were between the pylorus and the ampulla of Vater, 1 tumor being described as lying 2 cm. beyond the ampulla.

The authors conclude that the most frequent benign tumors is an adenomatous polyp; the most common non-epithelial benign tumor is a leiomyoma. There was scant evidence that benign mucosal polyps undergo malignant change. In only 1 case was a benign polyp found in the same stomach with a carcinoma.

Twenty roentgenograms.

JOHN P. FOTOPoulos, M.D.
Hartford, Conn.

Roentgenologic Examination of the Rectum and Colon. Robert E. Wise. Am. J. Surg. 90: 850-855, November 1955.

Adequate preparation for colon studies must include the mental preparation of the patient. The difficulty of finding a source of bleeding and the value of locating it should be explained in order to eliminate misunderstandings and encourage co-operation. Repeated studies with attendant costs otherwise lead to the assumption that an error has been made for which the patient is forced to pay. Physical preparation of the colon by laxatives, enemas, and low-residue diets involves discomfort and for this, also, an adequate explanation should be given. Castor oil is frequently ineffective, but by and large it has proved to be the most effective agent. Low or non-residue diet for several days before an air-contrast examination is helpful but is often impractical.

The usual examinations are the barium enema study and the air-contrast examination. The necessity for good visualization of the cecum on the barium enema

study produces a problem, because a proper air-contrast examination cannot be done with the sigmoid area obscured by barium in the ileum. The extra expense and discomfort to the patient of doing the procedures on separate days are therefore justified in order to obtain maximum benefit from each.

The barium enema study should, as a rule, be done first. If it fails to disclose the source of bleeding, an air-contrast examination must be undertaken. Even this, in spite of the greatest diligence and care in its performance and the optimum co-operation of the referring physician and patient, has its limitations. Residual fecal material is the greatest source of difficulty and confusion.

All polyps should be confirmed by a repeat air study before surgery. Adequate double-contrast visualization is enhanced by use of upright and lateral decubitus films, which produce a shift in location of the barium mixture, bringing it in contact with the various surfaces of the colon. This helps in differentiation of polyps from fecal material. The search for early tumors of the colon is helped by combining adequate spot-filming with fluoroscopic study and routine colon films.

When the combination of an initial barium enema and an air-contrast study fails to reveal the source of bleeding, the air study should be repeated several times. One negative examination is not sufficient. If repeated studies fail to reveal the bleeding point and the patient continues to bleed, a follow-up study should be done at intervals of three to six months until explanation for the bleeding has been obtained roentgenologically or otherwise.

Twelve roentgenograms. D. DEF. BAUER, M.D.
Coos Bay, Ore.

The Normal Ileo-Cecal Valve. S. L. Beranbaum and Kakarla Subbarao. *Am. J. Digest. Dis.* 22: 254-261, September 1955.

The various morphological variations and corresponding roentgenological appearances of the ileocecal region are described. As the ileum enters the cecum, the invaginated portion of the cecal wall forms two transverse lips, one above the other. The upper lip assumes a passive role while the lower lip plays an active mobile part in closing the valve in the distended colon.

Although the commonest site of the ileocecal valve is on the medial aspect of the cecum, it may be situated posteriorly or, if the cecum is partially rotated, it may be on the lateral wall. When the ileocecal valve is located on the posterior wall, there will be an ovoid filling defect with a thin line of barium across its horizontal axis. The average thickness of each lip ranges between 3 and 5 mm. Anything above 6 mm., as seen on a completely filled colon examination, is considered as hypertrophy.

Twenty-three roentgenograms; 1 photograph.
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Downey, Calif.

The Hypertrophied Ileo-Cecal Valve. S. L. Beranbaum and Kakarla Subbarao. *Am. J. Digest. Dis.* 22: 307-314, November 1955.

Confusion regarding the radiologic appearance of the ileocecal valve has arisen from lack of appreciation of variation in its size, shape, and position. The authors favor Hinkel's classification of the appearance of the valve: (1) normal-sized valve unusually conspicuous

because of odd site of insertion, distortion due to adhesions or membranes, or with a common ileocecal wall; (2) unusually large valve from edema, hypertrophy, fatty infiltration, or tumor; (3) invagination or prolapse of terminal ileum through the valve, (4) combinations of any of the preceding.

These benign conditions can be separated from malignant lesions, since the latter show irregularity of margins, asymmetry of the valve, and mucosal destruction. The defect produced by hypertrophy of the ileocecal valve is a smooth symmetrical enlargement of both upper and lower lips corresponding to valve structure. Serial films show variation in appearance, depending on the phase of action of the valve, while malignant changes are constant. The valve defects can be distinguished from cecal wall defects by their anatomical position and the characteristic appearance of the valve lips in most cases. Occasionally exploration may be warranted.

Lips over 6 mm. in thickness are considered hypertrophied, but size alone is not a criterion of malignant disease. In large defects contrast enemas are essential, and an attempt to demonstrate ileocecal valve incompetence is necessary to determine the relationship of defect to the valve. In large valves there is often some prolapse of ileal mucosa which resembles hypertrophy. The latter defect, however, is constant, while prolapse comes and goes and is more apt to show wrinkling. Prolapse does not produce symptoms and does not warrant exploration.

The authors conclude that ileocecal valve hypertrophy is common and may be confused with cancer or overlooked, unless its numerous variations in appearance are known and sought by the examiner.

Twenty-six roentgenograms.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Differential Diagnosis in Defects of the Ileocecal Junction. William G. Sauer, John R. Hodgson, John G. Mayne, and Edward S. Judd, Jr. *Gastroenterology* 29: 837-847, November 1955.

The well known clinical and roentgenologic criteria for diagnosis of lesions of the ileocecal junction are not infallible. In the presentation of 5 case reports the authors demonstrate the difficulty in differential diagnosis of prominent ileocecal valve lips, edema or prolapse of mucous membrane of the valve, and benign and malignant tumors.

Roentgen examination in the first case showed a large cecal mass, which on exploration proved to be an edematous ileocecal valve. A large filling defect in the cecum was observed in the second case but cecum and ileocecal valve appeared normal at operation. There was an adenocarcinoma of the right fallopian tube and of the omentum with no apparent relation to the cecal defect on the films. In the third case there was a large mass in the cecum which resembled an hypertrophied valve but proved to be a carcinoma. The mass was palpable, however, and the patient gave a history of earlier resection of carcinoma of the splenic flexure. The fourth patient presented a palpable mass of soft consistency suggestive of hypertrophy of the ileocecal valve and films demonstrated a lesion in the cecum thought to be inflammatory, with preservation of the mucous membrane pattern. The pathological diagnosis was adenocarcinoma. In the last case a polypoid lesion was observed roentgenologically and was thought, on palpation at exploration, to be a polyp. It

proved to be hypertrophy of the valve due to lipomatosis.

In doubtful cases of ileocecal involvement, when clinical and roentgenologic findings are equivocal, surgical intervention is advisable to establish a correct diagnosis and to avoid overlooking a malignant lesion. Even in the presence of accepted criteria, diagnosis may be hazardous.

Five roentgenograms. JOHN F. RIESSER, M.D.
Springfield, Ohio

Multiple Polyposis of the Colon, Osteomatosis and Soft-Tissue Tumors. Report of a Familial Syndrome.

Robert S. Weiner and Philip Cooper. *New England J. Med.* 253: 795-799, Nov. 10, 1955.

Multiple cutaneous and subcutaneous lesions, occurring simultaneously with hereditary polyposis and osteomatosis were described by Gardner and Richards in 1953 (*Am. J. Human Genet.* 5: 139, 1953). Six members of a family group of 51 living persons were affected. The present authors report 4 cases occurring in brothers ranging in age from twenty-eight to thirty-six years. All had multiple polyposis of the colon, 3 with malignant change in one or more of the polyps, even to the point of obstruction. In all 4, also, there were multiple exostoses in various bones: skull, mandible, maxillae, sinuses, humeri, phalanges, etc. One brother was fortunate in having undergone colectomy for the multiple polyposis before the occurrence of carcinomatous degeneration. The soft-tissue lesions included small cutaneous fibromas, an incisional fibrous-tissue tumor, and a desmoid in the right groin. One brother died at the age of thirty from extension of carcinoma of the rectosigmoid. He did not show soft-tissue tumors, presumably because of death before this latent tendency could become manifest.

Four roentgenograms; 2 photographs; 1 photomicrograph. SAUL SCHEFF, M.D.
Boston, Mass.

Leiomyosarcoma of the Rectum. Review of the Literature and Report of a Case. John D. Osmond, Jr., and Frederick R. Mautz. *Am. J. Roentgenol.* 74: 867-871, November 1955.

Leiomyosarcomas of the gastrointestinal tract are extremely rare and only 20 such lesions have been reported as occurring in the rectum. The authors present a case, with a review of the pathology, incidence, symptoms, differential diagnosis, and treatment.

Because of the rarity of sarcoma of the rectum, the correct diagnosis is seldom made until the histopathologic study is performed. The tumor is most frequently mistaken for carcinoma. There are, however, certain signs and symptoms which favor the diagnosis of sarcoma. These tumors are larger than carcinomas and encroach more upon the lumen of the rectum. The early symptoms are constipation, straining, and urinary difficulty. Carcinoma involves mucous membrane early to produce ulceration, infection, bleeding, pain, and subsequent cachexia. All of these are late manifestations of sarcoma. Regional lymphatic involvement is common in carcinoma and has not been found in sarcoma. Radical excision is the only satisfactory treatment because of the propensity to recurrence. Radiation therapy is not reported as being beneficial.

One roentgenogram; 1 drawing; 1 table.

WYNTON H. CARROLL, M.D.
Shreveport, La.

Barium Granuloma of the Rectum Following Barium Enema. Case Report. Lyle W. Swartz. *Am. J. Surg.* 90: 802-804, November 1955.

The author reports the occurrence of a barium granuloma in the anorectal region following the administration of a barium enema. Only one similar case was found in the literature (Beddoe, Kay, and Kaye: *J.A.M.A.* 154: 747, 1954. *Abst. in Radiology* 63: 898, 1954). Theoretically, barium ingested or instilled through the anus might lodge in a crypt, fissure, or internal fistula and infiltrate deeper tissues, causing a barium granuloma. The condition might be acute and immediately evident if sensory nerve fibers were involved. It might become chronic if undetected, in the absence of pain.

Two roentgenograms; 2 photomicrographs.

D. deF. BAUER, M.D.
Coos Bay, Ore.

Hemangioendothelioma of Liver Following Thorium Dioxide Administration. Henry Tesluk and Warren A. Nordin. *Arch. Path.* 60: 493-501, November 1955.

The authors present the autopsy findings in a case in which hemangioendotheliomatous lesions were encountered in the liver of a patient given Thorotrast (thorium dioxide) fourteen years previously for cerebral angiography. The relationship of the lesions to the thorium dioxide administration is discussed. Two similar cases of thorium dioxide-induced neoplasms of the liver have been recorded. One of these is from the American literature (MacMahon, Murphy, and Bates: *Am. J. Path.* 23: 585, 1947. *Abst. in Radiology* 50: 724, 1948).

Eight illustrations.

Intravenous Cholangiography. Results in One Hundred Cholecystectomized Patients with Upper Abdominal Symptoms. David J. Sandweiss and Harold Fulton. *J.A.M.A.* 159: 998-1001, Nov. 5, 1955.

One hundred cholecystectomized patients were studied with Cholografin because of persistent or recurrent symptoms suggesting biliary disease. The common duct and major hepatic radicals were sufficiently opacified for identification and study in 94 of the 100 cases. All whose ducts were not demonstrated had impaired liver function.

Excluding duplications, of the 94 patients whose common ducts were visualized, 34 patients (36 per cent) showed normal cholangiograms, 7 patients (7 per cent) showed stones in the common duct, and 3 patients (3 per cent) showed dilated cystic duct stumps or "re-formed" gallbladders. In this group of 44 patients (46 per cent) the cholangiographic findings were either definitely normal or definitely abnormal. Twenty-five (27 per cent) of the 94 patients showed moderate to marked dilatation of the common ducts, but stones were not seen on the cholangiograms. In 24 patients (26 per cent) the common ducts were of normal width, but the terminal ends of the ducts were not visualized. In this group of 49 patients (53 per cent) the cholangiographic findings were equivocal.

The authors consider the maximum normal transverse diameter of the opacified common duct to be 8 mm. as measured on the film. Their studies indicate that following cholecystectomy dilatation of the common duct may or may not develop, and in neither event

is a significant pathological condition necessarily present. Some cases showed stones without dilatation of the common duct and many showed an increased duct caliber without stones or stenosis of the sphincter of Oddi. The incidence of false negative cholangiograms is not yet known. One-fourth of the patients had unexplained moderate to marked dilatation of the common duct. The authors point out that failure to demonstrate small stones does not rule out their presence. Examination of patients with jaundice ordinarily does not result in diagnostic cholangiograms.

Three roentgenograms, 3 tables.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Limitations to the Clinical Application of Intravenous Cholangiography in Determining Disease of the Bile Ducts after Cholecystectomy. Francis E. McDonough and Robert E. Wise. *Gastroenterology* 29: 771-784, November 1955.

The main limitations of intravenous cholangiography with Cholografin after cholecystectomy are: (1) failure to visualize the duct system in the presence of jaundice or significant liver damage; (2) inability to demonstrate retained cystic duct stumps obstructed by non-opaque stones; (3) failure to demonstrate all non-opaque calculi in the bile ducts; (4) erroneous or equivocal interpretation.

In 114 cases in which intravenous cholangiograms were obtained on cholecystomized patients, the clinical diagnosis was confirmed in 54; the examination proved to be essential to the diagnosis in 18; there was failure of visualization in 17; results were equivocal in 17 and erroneous in 8 patients. Thus, while Cholografin is shown to be a valuable diagnostic aid, clinical evaluation of symptoms, physical findings, and accepted laboratory procedures remain of primary importance in handling of these patients.

Cystic duct and gallbladder remnants, with or without stones, are demonstrable when present by opacification similar to that of the common duct and are identified by relationship to it. Stones in the common or hepatic ducts are visualized directly, when opaque, or as filling defects. Partial obstruction may be noted, with dilatation of the duct, tortuosity, and distal narrowing, often associated with fibrosis of the sphincter of Oddi. Stones were demonstrated on the intravenous cholangiograms in only 50 per cent of the visualized postcholecystectomy common ducts that subsequently were found to contain stones at operation. There were no serious reactions to the medium; mild reactions occurred in approximately 11 per cent of the patients.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Cholecystographic Studies During and Immediately Following Acute Pancreatitis. Van G. Kaden, John M. Howard, and Leonard C. Doubleday. *Surgery* 38: 1082-1086, December 1955.

The correct differential diagnosis between acute cholecystitis and acute pancreatitis is essential since one responds well to early surgical intervention and the other to non-operative management. The distinction may not be an easy one, especially when the patient is first seen several days after the onset of the disease. Since acute cholecystitis is associated with roentgenographic non-visualization of the gallbladder, this finding has been used to distinguish between the two condi-

tions. To test the validity of this criterion, the authors studied 23 patients during the first week of convalescence from acute pancreatitis. Cholecystography revealed a normal gallbladder in 8 patients. There was non-visualization of the gallbladder in 11 instances and impaired function in an additional 4 (a total of 65 per cent). Repeat cholecystography during the ensuing months or surgical exploration indicated that these patients had no organic disease of the gallbladder. The return of cholecystic function, as demonstrated by cholecystographic studies, characteristically occurred within a month after the symptoms of acute pancreatitis had subsided.

The authors conclude that during the first week of illness with acute pancreatitis, a cholecystogram is of diagnostic assistance only if the gallbladder is visualized, for non-visualization at this time does not necessarily indicate organic cholecystic disease.

Six roentgenograms.

Cholecystographic Demonstration of Rokitsky-Aschoff Sinuses of the Gallbladder. Harold D. Rosenbaum. *J. Kentucky M. A.* 53: 956-958, November 1955.

A case of cholecystographic demonstration of Rokitsky-Aschoff sinuses of the gallbladder is reported; it is believed to represent the fifteenth such instance recorded in the literature.

The roentgen picture is pathognomonic: pockets of contrast material lie immediately outside and more or less surround the gallbladder lumen. Constriction of the gallbladder is frequently an associated finding. Cholecystographic visualization of these sinuses has been found to be a reliable indication of significant gallbladder disease.

In the author's patient, a twenty-nine-year-old female, cholecystograms with Telepaque showed the entire gallbladder shadow encircled by an interrupted ring of contrast material. Films following a fatty meal revealed almost complete emptying of the gallbladder, but there was little change, except for contraction, in the ring of opaque material.

It is noted that Rokitsky-Aschoff sinuses are frequently encountered at pathologic examination; the rarity of their demonstration by cholecystography is probably due to (a) the inability of the diseased gallbladder to concentrate the medium sufficiently, (b) the small size of many of the herniations, and (c) the failure of the medium to displace the normal contents of the sinuses. In fact, the necks of the sinuses frequently become occluded. It is likely that these sinuses will be visualized more frequently in the future, with the use of cholecystographic agents which permit deeper contrast than has previously been possible.

Two roentgenograms; 1 photomicrograph.

An Unusual Case of Vesicular Exclusion. J. P. May and J. Moussard. *J. de radiol. et d'électrol.* 36: 876, November-December 1955. (In French)

This is a brief report of a case in which oral cholecystography with Telepaque demonstrated a poorly functioning gallbladder with a dense opacity medial to the fundus. Further studies revealed a large duodenal diverticulum, which apparently retained the opaque medium.

Two roentgenograms.

CHARLES M. NICE, JR., M.D.
University of Minnesota

THE MUSCULOSKELETAL SYSTEM

A Roentgenologic Study of a Human Population Exposed to High-Fluoride Domestic Water. A Ten-Year Study. Nicholas C. Leone, Clyde A. Stevenson, Theodore F. Hilbish, and Merrill C. Sosman. *Am. J. Roentgenol.* 74: 874-885, November 1955.

The object of this report is to present the roentgenographic bone findings observed in a ten-year study of 237 persons, approximately one-half residing in an area (Bartlett, Texas) where the drinking water contained a high concentration of fluoride (8 parts per million) and the other half in a control area (Cameron, Texas), where the fluoride content of the water supply was low (0.4 ppm), and to describe the findings that might be ascribed to prolonged fluoride ingestion. Comparative evidence of bone changes from a long-term study of cattle is also presented.

The findings in the human series are limited to an evaluation of anteroposterior views of the lumbar spine, sacrum, pelvis, trochanters, and proximal third of the femurs. Films made in 1943 were compared with similar views of the same region, in the same individuals, obtained in 1953. Interpretation of the findings was based on those bone changes which have been generally considered to be found in association with exposure to and ingestion of excessive amounts of fluorides—i.e., increased bone density, coarsened trabeculation, hypertrophic change, and ligamentous calcification. Bone spurs unassociated with hypertrophic change and osteoporosis associated with aging and postmenopausal syndrome were also considered. Evaluations were made on the basis of sex, age, activity, study area, and elapsed time.

A limited number of persons from both series showed some degree of bone change, but in general these changes were minimal. The following types of roentgenographic bone conditions were seen among the persons using the water supply containing excessive fluorides: increased bone density, with or without coarsened trabeculation, with a ground-glass appearance; coarsened trabeculation showing lines of stress without increase in density; increased thickening of cortical bone and periosteum, with equivocal narrowing of the bone-marrow spaces (also demonstrated in cattle at toxic levels).

It is thus concluded that excessive fluorides in a water supply may produce roentgenographic evidence of bone changes, but this is true of only 10 to 15 per cent of exposed persons; the changes are slight and often difficult to recognize, and they are not associated with other physical findings except for dental mottling in persons exposed during the tooth-formative period.

There is some indication that ingestion of excessive fluoride in water and the "fluoride effect" of the degree encountered in this study, may, on occasion, have a beneficial effect in adult bone, as in counteracting the osteoporotic changes of the aged.

Seventeen roentgenograms.

WYNTON H. CARROLL, M.D.
Shreveport, La.

Multiple Pseudo-Cystic Tuberculosis of Bone. Report of a Case. C. L. Clinton-Thomas and W. B. Young. *J. Bone & Joint Surg.* 37-B: 624-631, November 1955.

The authors report a case of multiple bone lesions in a healthy appearing Chinese boy of three years. Chest

roentgenograms were typical of a primary tuberculous complex, the Mantoux test was positive, and histologic examination of tissue obtained from one of the bone lesions showed characteristic "tubercles" consisting of giant cells, epithelioid cells, and fibroblasts. On the basis of these findings and the results of streptomycin therapy, a tuberculous etiology was considered unquestionable, though no acid-fast bacilli were found in the sputum, gastric washings, feces, or the biopsy specimen mentioned above.

The bony lesions were widespread, involving the long bones, ribs, and feet. They appeared on the films as oval areas of destruction with regular, clearly defined margins and a tendency to be symmetrically and centrifugally situated with reference to the axial skeleton. Response to streptomycin and PAS was prompt, and ten months after admission to the hospital healing was practically complete.

The literature is reviewed, and 30 recorded cases are tabulated. The condition is relatively benign, with little constitutional disturbance and a tendency to spontaneous regression. Joint involvement is unusual. The widespread distribution of the lesions, their simultaneous onset, and the similarity of their radiographic appearances are evidence of hematogenous dissemination over a short time.

Twelve roentgenograms; 2 photomicrographs; 1 table.

JOHN F. BERRY, M.D.
University of Louisville

Two Cases of Turner's Syndrome. P. Kaufmann. *Schweiz. med. Wchnschr.* 85: 1027-1028, Oct. 15, 1955. (In German)

The author presents 2 cases of Turner's syndrome and summarizes the features of the condition as follows:

1. *Development:* Retardation of growth; disturbances in ossification; disturbances in sexual development; frequent malformations, such as cubitus valgus, pterygium colli, and Madelung's deformity.

2. *Sex:* Female.

3. *Symptomatology:* Proportionate growth retardation; normal intelligence; primary amenorrhea; congenital malformations; secondary sex characters lacking or poorly developed; absence or poor development of the ovaries; follicle-stimulating hormone usually elevated but at times lowered in urine.

4. *Roentgen findings:* Frequent osteoporosis; changes in the spine, such as spina bifida and scoliosis; sella normal or small; delayed epiphyseal growth.

5. *Etiology:* Probably defective germ plasm. The large variety of signs will not allow them to be put into a single endocrinopathic framework.

6. *Adrenals:* 17-ketosteroids at times diminished.

The differential diagnosis concerns chiefly growth disturbances of pituitary origin. In such cases the subjects are usually smaller, 17-ketosteroids are diminished, follicle-stimulating hormone is low, and there are usually no congenital malformations.

[For the combination of Turner's syndrome and coarctation of the aorta, see Smitham: *J. Fac. Radiologists* 1: 198, 1950.]

Two illustrations. CHRISTIAN V. CIMMINO, M.D.
Fredericksturg, Va.

Two Cases of the Syndrome of Klippel-Trenaunay. S. Bourgeois and P. Robert. *J. de radiol et d'électrol.* 36: 915-918, November-December 1955. (In French)
In 1900, Klippel and Trenaunay described a clinical

syndrome which they called "osteohypertrophic varicose nevus," characterized by a vascular nevus, unilateral superficial varicose veins, and hypertrophy (elongation or widening) of the skeleton on the affected side.

Two patients with this syndrome are presented: a fifty-year-old woman with involvement of the right lower extremity and a five-year-old boy with an asymmetrical skull, unilateral skeletal hypertrophy, and a large vascular nevus on the sacrum.

This syndrome has also been designated as vasculo-osseous dysembryoplasia. Arteriovenous communications may occur in the affected areas.

Seven roentgenograms; 3 photographs.

CHARLES M. NICE, JR., M.D.
University of Minnesota

Clarification of the Problem of Vertebral Fractures from Convulsive Therapy. I. Incidence. Constance L. Newbury and Lewis E. Etter. *Arch. Neurol. & Psychiat.* **74**: 472-478, November 1955.

Review of the literature pertaining to the skeletal complications resulting from convulsive therapy shows few statistical studies dealing with other than vertebral fractures. Vertebral fractures have been reported in association with insulin coma therapy, Metrazol convulsive therapy, and electroconvulsive therapy (ECT). Their recognition is dependent upon careful roentgen search with pre- and post-therapy film studies. By far the greater number of vertebral fractures resulting from convulsive therapy are subjectively asymptomatic and objectively without sign of structural change on the basis of clinical examination alone. Roentgen examination, with interpretation by a radiologist, is therefore essential. In one study in 1939, involving 3,000 cases, no roentgenograms were obtained and the incidence of vertebral compression fractures was given as zero. In another study, covering 51 cases, routine x-ray examination after treatment showed an incidence of 43.1 per cent.

Factors relating to incidence are difficult to evaluate. There is no clear-cut correlation with age, sex, race, etc. It is notoriously difficult in clinical research to control conditions sufficiently to permit evaluation of an isolated factor.

There are 54 references listed for this paper and 40 statistical studies were used in arriving at the conclusions reported. Five tables are included.

See also following abstract.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Clarification of the Problem of Vertebral Fractures from Convulsive Therapy. II. Roentgenological Considerations. Constance L. Newbury and Lewis E. Etter. *Arch. Neurol. & Psychiat.* **74**: 479-487, November 1955.

In one year—Feb. 1, 1953, to Jan. 31, 1954—106 patients received electroconvulsive therapy at Western Psychiatric Institute and Clinics, University of Pittsburgh. Adequate pre- and post-therapy data were available for 85 patients, ranging in age from sixteen to seventy-three years. Curare was used in only 13 of the series and in only 2 of the 23 who sustained vertebral fractures during the treatments. The overall incidence of fractures was 27 per cent and, as in other studies, the region from T-4 to T-8 was most frequently involved. The factors of age and sex did not appear to be of

significance. Seventy-five per cent of those sustaining fractures did not complain of pain.

The authors stress the importance of admission x-ray examinations to determine the presence of previous trauma and other pathological changes. Accurate measurements of vertebral vertical heights must be made in millimeters with marks at the exact anterior edges of the vertebral plates above and below. It is possible thus to appraise accurately the existence of compression of at least 2 mm. It is not sufficient merely to make a visual estimation. The failure to make accurate comparative measurements may account for some of the wide variations in reports of incidence of compression fractures.

Nine roentgenograms; 3 tables.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Hemangioma of a Dorsal Vertebra with Collapse and Compression Myelopathy. Robert L. Bell. *J. Neurosurg.* **12**: 570-576, November 1955.

While vertebral hemangiomas are seldom of clinical significance, a few undergo proliferative and degenerative changes. Tumor expansion results from endothelial budding and subsequent canalization of the outgrowths. Cancellous bone is encroached upon by these newly formed channels and assumes a colonnade effect, readily recognized roentgenologically. These reactive trabeculae may become enlarged to as much as three times their normal size.

Occasionally proliferative and degenerative changes in a hemangioma will lead to dysfunction of the spinal cord. Three modes of encroachment on the vertebral canal resulting in compression myelopathy are described: deformation of the centrum subsequent to collapse; extension of the angioma into the regional epidural space; hypertrophy and thickening of the vertebral arch. A review of the literature showed massive vertebral collapse to be of rare occurrence. Five previously recorded cases are summarized.

The author reports a further case in detail. The lesion, occurring in a 25-year-old female, was confined to the tenth thoracic vertebra. Laminectomy was performed for compression symptoms, and was followed by almost total dissolution of the involved vertebra. Recovery occurred over a period of four years, after further surgery, roentgen therapy, and the use of braces.

This sequence of events serves as a warning against overestimating the strength of a vertebra involved by hemangioma. In the presence of clinical evidence of compression myelopathy, the author considers laminectomy to be clearly indicated. Judicious use of radiation (dosage not stated) is indicated following operation, but is not recommended preoperatively. Follow-up films should be obtained at intervals. If beginning or partial collapse is disclosed, a fusion operation should be performed.

Three roentgenograms; 1 photomicrograph.

C. M. GREENWALD, M.D.
Cleveland Clinic

Sacral Extradural Cyst: An Uncommon Cause of Low Back Pain. Peter H. Schurr. *J. Bone & Joint Surg.* **37-B**: 601-605, November 1955.

The author reports a case of low back pain due to an extradural cyst occurring in the sacral region.

There are no constant clinical factors which allow

differentiation of sacral extradural cysts from perineurial cysts or a prolapsed nucleus pulposus. The radiologic appearances, however, may be of the utmost value for making the distinction, since bone is generally expanded and eroded only by the extradural variety. Myelography amplifies the information and, if the contrast material does not readily enter the cyst, late films should be taken since passage may be slow. Perineurial cysts do not usually communicate with the subarachnoid space sufficiently freely for them to be filled. The presence of contrast medium within a sac, in conjunction with erosion of bone or widening of the vertebral canal is strong evidence in favor of an extradural cyst. The author's case showed all of these features.

Six roentgenograms; 1 drawing.

T. E. PADGETT, M.D.
University of Louisville

Spontaneous Rib Fractures After Radical Mastectomy. J. R. von Ronnen. *J. belge de radiol.* **38**: 525-534, 1955. (In Dutch)

In 2 patients spontaneous rib fractures were observed on the side of operation within two and a half and four years, respectively, after radical mastectomy for carcinoma of the breast. Although both patients had received postoperative irradiation, radio-osteitis (radio-necrosis) could be ruled out, and there was no evidence of demineralization (osteoporosis) or of metastatic activity.

The patients had not been subjected to physical efforts, cough, or straining (difficult defecation), and detailed histories failed to provide a "natural" explanation for the fractures. In the first case, the pain had been felt for the first time as the patient turned in bed; in the second following hicough.

The author believes that these fractures were caused by violent and incoordinate contractions of the serratus and of the long muscles of the back, resulting from the muscular imbalance caused by the removal of the pectoralis major and minor during mastectomy.

Six roentgenograms. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

The Cysts of Osteoarthritis of the Hip. A Radiological and Pathological Study. K. Rhaney and D. W. Lamb. *J. Bone & Joint Surg.* **37-B**: 663-675, November 1955.

The authors present various hypotheses that have been offered in the past to explain the cystic changes and bony defects seen radiographically and microscopically in the subarticular area of the femoral head in patients with advanced osteoarthritis. This is followed by their own radiological, macroscopic, and histological observations on 36 patients with advanced osteoarthritis of the hip treated by excision of the femoral head by the method of Judet and Judet.

It is the very nature of osteoarthritis to expose subarticular bone to injury, particularly in the weight-bearing joints. The authors believe that in osteoarthritis the shock of jolting movements at the hip, normally absorbed by the protective resilience of healthy articular cartilage, injures the bone at the site of the impact and the shock is transmitted to the subjacent trabeculae. This results in fracture and necrosis of the weaker trabeculae deep below the surface, with cavity formation. The presence of cysts filled with fluid at the site of injury is certainly

the result of the disruption of the articular surface so that synovial fluid is forced into the bone under the pressure of the weight of the body.

The fact that synovial fluid is not always present at the site of subarticular injury, even when the surface bone is disrupted, leads the authors to conclude that the bone destruction precedes, and is independent of, the entrance of synovial fluid into the bone, and that, if the surface remains intact until the deranged focus is filled with granulation tissue, the formation of cavities containing synovial fluid will not occur. On the other hand, it is felt that, should synovial fluid enter the necrotic bone, it is likely to disrupt the already devitalized tissue, which may then be swept into the cavity of the joint, leaving a potential space in which synovial fluid becomes encysted during the stage of repair.

These sites of fracture and necrosis may become visible radiologically once devitalized fragments of bone have been removed either by osteoclastic activity or by being shed into the cavity of the joint.

It is contended, therefore, that "the cysts of osteoarthritis are sites of injury that often, if not invariably, contain encysted synovial fluid, and the persistence of the radiographic defect is an indication that continued use of the joint has impeded the natural processes of repair."

Eighteen illustrations, including roentgenograms, photographs, and photomicrographs.

CLAUDE D. BAKER, M.D.
University of Louisville

The X-Ray Picture of Swelling of the Capsule of the Knee Joint. F. A. Beek. *J. belge de radiol.* **38**: 535-545, 1955. (In English)

Swelling of the capsule of the knee joint may be diagnosed from the following roentgenographic features (determined from an analysis of 36 cases): (1) widening of the space between patella and condyle; (2) pear-shaped shadow of fluid-filled suprapatellar recess; (3) swelling of the suprapatellar soft tissues, behind the quadriceps; (4) forward displacement of the plicae alares; (5) swelling of the soft tissues behind the femoral condyle; (6) forward displacement of the patella and increased joint space; (7) soft-tissue swelling to both sides of the joint space, as seen on frontal views.

Eleven roentgenograms; 1 drawing.
E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Densimetry. Evaluation of Calcium Content of Bones. B. J. Rethmeier. *J. belge de radiol.* **38**: 487-500, 1955. (In Dutch)

The author describes a method and the apparatus employed for estimating the degree of mineralization (*i.e.*, content of calcium phosphate) of bone. It consists of comparative (photoelectric cell) densitometry of the "opacities" cast by a phalanx and by an ivory wedge, roentgenographed simultaneously on an otherwise conventional frontal view of the hand.

One roentgenogram, 5 photographs, 1 drawing.
E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Transplantation of Epiphyseal Cartilage. An Experimental Study. P. A. Ring. *J. Bone & Joint Surg.* **37-B**: 642-657, November 1955.

In the study reported here autogenous and homo-

genous grafts transplanted to the distal end of the ulna in young rabbits were evaluated radiologically, histologically, and as to degree of growth. The technic of transplantation is described.

Radiographic features associated with failure to grow were: (1) complete disorganization within the grafted area, (2) calcification within the epiphyseal cartilage, and (3) narrowing of the epiphyseal cartilage. Transplantations considered successful showed the following features during the period of growth: (1) a band of radiotranslucency corresponding to the normal epiphysis; (2) clouding of the metaphysis, indicating a normally active epiphyseal cartilage; (3) a normally curved radius; (4) a steady increase in length of the ulna. In the animals receiving autogenous grafts, serial histologic examinations revealed central necrosis in all cases, with subsequent bony union of some degree between the epiphysis and metaphysis.

Autogenous transposition was followed by normal growth in 5 of 18 animals. Homogenous grafting was unsuccessful in all cases. It gives rise to an immunity reaction confined to the reserve zone of the cartilage.

Nine roentgenograms; 9 photomicrographs; 6 tables.

JACK H. PURCELL, M.D.
University of Louisville

GYNECOLOGY AND OBSTETRICS

Pneumocography as an Aid in the Diagnosis of Gynecologic Disease. Bernard S. Abrams and Anson Hughes. *Am. J. Obst. & Gynec.* 70: 1115-1125, November 1955.

Pneumocography is the process of obtaining a radiograph projected through the pelvis following injection of gas into the peritoneal cavity. Observations on 161 cases in which pneumoperitoneum was induced transabdominally led the authors to the conclusion that the procedure was a definite aid in the diagnosis of pelvic disease. In the obese or unco-operative patient and when the examiner could not be certain of his bimanual findings, pneumocography was of special value. In 3 cases, demonstration of a normal uterus spared a laparotomy. Ovarian cysts, adnexal tumors, subserous fibroids, and adhesions between the gut and pelvic organs were easily visualized. Inflammatory disease, binding down the pelvic structures, and large pelvic tumors were poorly demonstrated, as no carbon dioxide would surround these lesions. In such cases, however, the procedure is unnecessary for diagnosis.

In the majority of cases bimanual examination is adequate and one is not justified in subjecting a patient to discomfort to verify the presence of a known disease. When indicated, however, pneumocography is a valuable adjunct in the diagnosis of gynecologic disorders. It is a safe procedure and the technic is not difficult.

ROBERT L. EGAN, M.D.
University of Texas, Houston

The Flat Sacrum: Its Importance in Obstetrics. A. Charles Posner, Norman R. Bloch, and Norman S. Posner. *Am. J. Obst. & Gynec.* 70: 1021-1025, November 1955.

In five years, 12,787 deliveries were performed at the Bronx Hospital, New York. In 2,068 patients x-ray pelvimetric examinations were done, and 440 (21.3 per cent) were found to have flat sacra. The incidence does not vary significantly from other series. The Snow technic of pelvimetry was used.

Labor was prolonged in 40.2 per cent of the flat-sacrum group. The cesarean section rate was 3.6 times as great and the percentage of mid-forceps deliveries 2.3 times as high in this group as in the total series of deliveries. Breech presentation was, proportionately, 3.6 times as frequent.

The flat sacrum was associated with various types of pelvic contractions: the anteroposterior diameters were often contracted if the flat sacrum inclined forward; the transverse diameters were shortened in funnel-type pelves.

Attempted midforceps delivery in the presence of a flat sacrum is often impossible if rotation is tried in the mid-pelvis. Traction should first be applied to the vertex in the transverse position until bulging of the perineum occurs; rotation of the head can then be done and delivery completed. With a backward sweep of the flat sacrum, the vertex may suddenly pass, after prolonged mid-pelvic transverse arrest, with precipitate delivery through the increased posterior sagittal diameter.

Three tables.

ROBERT L. EGAN, M.D.
University of Texas, Houston

Repeated Spontaneous Version of a Dead Fetus. Stanley M. Mendelowitz. *Am. J. Obst. & Gynec.* 70: 1150-1153, November 1955.

A case of spontaneous version of a dead fetus at the thirty-fifth week of pregnancy is reported. The initial x-ray examination done thirty-six hours after cessation of fetal movements revealed a frank breech presentation. A second examination three days later showed the vertex presenting, with early signs of fetal death. The third film, eight days after the original, showed reversion to the breech position and signs of fetal death were unmistakable. At delivery of the macerated fetus two weeks later, the shoulder presented.

The author concludes that a living active fetus is not necessary for spontaneous version.

Four roentgenograms. ROBERT L. EGAN, M.D.
University of Texas, Houston

THE GENITOURINARY SYSTEM

Diatrizoate for Excretion Urography. Report of 100 Cases. Michael T. Mahoney. *J. M. Soc. New Jersey* 52: 586-587, November 1955.

The authors used Hypaque in 100 consecutive unselected patients for intravenous urography. The age range was from two to eighty-seven years, and 32 of the 100 were females. A test dose of 1.0 c.c. was given intravenously and each patient was observed for twenty minutes. None exhibited allergic reactions or side-effects from the test dose. The medium was then injected intravenously as rapidly as possible through an 18- or 20-gauge needle. Each adult received 30 c.c. and children were given proportionately smaller amounts. For a two-year-old child the medium was diluted with equal parts of isotonic saline and injected intramuscularly into the gluteal muscles, with no ill effects.

The best urograms were obtained at five, fifteen and thirty minutes after the injection, with the last film usually presenting an excellent cystogram. Eighty-eight per cent of the films were satisfactory for diagnostic purposes. Many of those classed as "fair" or "poor" were of patients with poor renal function.

Only 9 per cent of the patients experienced side-

effects, such as did occur being mild and transient. There was no severe allergic reaction. Of the few patients with side-effects, 66 per cent had a previous history of allergy or drug idiosyncrasy.

The author concludes that the excellent contrast afforded by Hypaque, with a lessened incidence of minor side-effects, makes it a useful diagnostic medium for the urologist and radiologist.

One roentgenogram. JOHN P. FOTOPoulos, M.D.
Hartford, Conn.

Combined Angionephrography and Stratigraphy. John A. Evans and Antonio F. Govoni. *Radiol. med. (Milan)* 41: 1120-1130, November 1955. (In Italian)

The authors devised a procedure for obtaining precise delineation of functioning renal parenchyma by combining renal angiography and body-section roentgenography. Their investigation was carried out on 105 patients, and its results are reported. It is believed that the method gives very clear definition of the renal morphologic anatomy and of space-occupying lesions; moreover, the single plane section eliminates the shadows of the overlying intestinal gas which make difficult the interpretation of plain nephrograms.

This combined technic is of greatest value in differentiating cysts from tumors. The cysts appear as sharply outlined, non-vascularized, round, radiolucent areas, surrounded by opaque renal parenchyma. In the arteriographic phase of the examination a distortion of the vascular pattern may be noted (tangential deflection of the interlobular arteries around the cystic structure). Neoplasms do not show the well defined outlines observed in cysts. They are rather opacified and appear to blend with the surrounding renal substance. The density of the tumor shadow is not as marked as that of the unaltered parenchyma, and a peculiar vascular network in the tumor may be demonstrated by arteriograms.

The renal outline is sharply defined, which is important in differentiating renal from extrarenal masses and in demonstrating congenital anomalies. Iodine sensitivity, poor renal function (Pendergrass), and cardiac failure represent the most important contraindications. Any patient who is not a good anesthesia risk should not be subjected to the procedure. An untoward side-effect is a diffuse sensation of warmth, lasting, however, only a few seconds.

[See also Evans *et al.*: *Radiology* 64: 655, 1955.]

Twenty-five roentgenograms; 2 tables.

R. G. OLIVETTI, M.D.
Newington, Conn.

Use of Bag Ureteral Catheters for Nephrograms: Obstructive Nephrograms. Carl D. Berry, Jr., and Roland R. Cross, Jr. *J. Urol.* 74: 683-692, November 1955.

Nephrograms may be produced by concentration of contrast material in the vascular network of the kidney (aortography and rapid intravenous nephrography) or concentration of the medium in the renal tubules. The latter is accomplished by acute ureteral obstruction with suppression of glomerular filtration but continuation of tubular function, so that iodides may be secreted into the tubules and there remain to create a diffuse accentuation of the kidney on the roentgenogram.

Ureteral obstruction is readily achieved using a 5F

ureteral catheter with a filiform tip and a latex sheath 1.5 cm. in length secured over the hole near the tip. The catheter is inserted into the abdominal portion of the ureter cystoscopically and the bag is inflated with 0.5 c.c. of Skiodan. Fifteen minutes is allowed to elapse; 25 c.c. of 70 per cent Urokon is then given intravenously. Films are taken every fifteen to thirty minutes until the desired nephrogram is attained (usually forty-five to sixty minutes). The patient may be moved from the radiographic table between roentgenograms. Following release of the catheter he is placed in the upright position and an excellent visualization of the collecting system may be obtained.

Bilateral ureteral obstruction produces the best nephrograms but unilateral obstruction will give good results, and contralateral obstruction will often afford a good nephrogram.

Discomfort is slight, and no renal damage has occurred.

Five roentgenograms; 1 photograph.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Vesicoureteral Reflux in Children. John A. Hutch, Raymond G. Bunge, and Rubin H. Flocks. *J. Urol.* 74: 607-620, November 1955.

The study reported in this paper was undertaken to determine the applicability of an operation previously described by one of the authors (Hutch: *J. Urol.* 68: 457, 1952) to the correction of vesicoureteral reflux in children.

Three normal defenses against vesicoureteral reflux exist: compression of the intravesical ureter by the bladder musculature as intravesical pressure rises; contraction of the longitudinal fibers of the intravesical ureter following expulsion of urine into the bladder; pulling down of the ureters by contraction of the trigone, thus increasing the length of the intravesical segment. Any disease which destroys the normal dynamic relationship of the bladder wall, the intravesical ureter, and the trigone may result in vesicoureteral reflux.

Eight children manifesting symptomatic vesicoureteral reflux were subjected to dissection of the intramural ureter and the creation of an intravesical ureter by pulling the ureter through the defect. In only 2 of a total of 14 ureters was there a recurrence of reflux following the repair. All 8 patients were symptomatically improved or cured and in 5 there was a return to normal of the previously dilated upper urinary tract as visualized roentgenographically.

Twenty-four roentgenograms.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

TECHNIC

The Universal Use in Routine Roentgenology of Photofluorography with Small Focal Spot and Magnification. P. Fries and E. Liese. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 83: 710-721, November 1955. (In German)

The unsharpness in photofluorography is said to be due to scattering within the luminescent screen rather than to the coarse grain of the latter. The authors used the method with up to 3:1 magnification (0.3-mm. focal spot and increase of the object-screen distance), and believe that thus the structural details of the object are so well separated on the screen as to compensate

for its unsharpness. With this arrangement, the range of photofluorography encompasses most skeletal studies, enlargements of small areas of the chest, and any of the contrast procedures, particularly repeated views during angiocardiology. The result is a substantial reduction in cost, which is the basic reason for this development.

With a triphasic x-ray transformer, high-kilovoltage technic, substantial filtration of the beam, and not less than 35 cm. target-object distance, the skin dose can be maintained within acceptable limits. For full or half-wave rectification, it would be necessary to go to 125 kv, and it might be difficult to avoid critical thermal levels in the tube. For certain exposures (frontal views of hand or wrist) 65 to 70 kv can be used. Skull views are magnified only 1.5 times, but generally higher limits are desirable, e.g. an anteroposterior view of the ankle is taken with 3:1 magnification at 35 cm. target-object and 90 cm. target-screen distance, giving 25 mas at 110 kv and 4 mm. Al filtration, which results in 2.5 r to the skin.

In practice, this method may be combined with conventional roentgenography. For skeletal parts one routine (orientation) film and several photofluorograms may be obtained; in urography, serial photofluorograms will determine the proper moment when the large roentgenogram shall be exposed. Those interested in this procedure should consult the many technical details given in the original text.

Ten roentgenograms; 2 photographs; 1 drawing; 3 tables.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Transverse Body-Section Photofluorography. W. Bader and K. E. Scheer. Fortschr. a. d. Geb. d. Röntgenstrahlen 83: 721-724, November 1955. (In German)

The authors describe their technic for sectional fluorography. A Voigtländer camera (70 × 70-mm. film size, 100 mm. f: 1.5 Sonnar lens) is attached to an aluminum cone (wall thickness 1.0 mm., length 90 cm., base diameter 50 cm.), which covers a square (35 × 35 cm.) luminescent screen. This cone (weight 11.8 kg.) can be easily bolted to the rotating platter of the Siemens model for transverse body-section roentgenography.

Photofluorography is today still inferior to conventional roentgenography because of the loss of definition due to the luminescent screen. Body-section films are however, inherently unsharp, and photofluorographic planigrams were equal in quality to those obtained directly on film.

The authors used the transverse body-section method mainly for chest cases, and particularly as a guide for beam localization and dose calculation in rotational radiation therapy, which necessitates a 1:1 scale. However, the transverse sections result in 1:1.38 magnification. This was obviated by optical minification of the photofluorogram at the time of exposure, with subsequent enlargement to the desired 1:1 size.

Two roentgenograms; 2 photographs.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Three Dimensional Stratigraphic Examination. Axial Transverse Stratigraphy. Part II. Pietro Amisano. Am. J. Roentgenol. 74: 777-790, November 1955.

This article emerges from the Institute of Radiology,

University of Genoa, directed by Professor Alessandro Vallebona, one of the early pioneers in stratigraphy, who effected the first practical realization of the axial transverse stratigraphic technic in 1947. [Note that this school prefers the term *stratigraphy* to any of the commonly used synonyms.]

While ordinary stratigraphy depends on exclusion by motion of shadows above and below the desired field, the axial transverse technic depends upon the elimination of unwanted shadows by rotational displacement. The upright patient and horizontal film both undergo identical (speed and direction) rotation, their axes of rotation being parallel, with a stationary x-ray beam directed obliquely at the patient. Only the field of interest is projected upon the film during the entire exposure. Points in the fields above and below the field of interest appear only part of the exposure time or not at all. "The elimination of shadows is proportionate to the shift of the images and therefore increases proportionately with increase of the distance from the chosen geometrical layer." A diagram in the article clearly illustrates the geometrical principles.

The apparatus, built according to the specifications of the University of Genoa, is suitable for standard radiography and ordinary stratigraphy as well as for axial transverse stratigraphy. Indeed, the considerably shorter exposure time necessary for the ordinary stratigraphic examinations performed on this apparatus is a distinct advantage over the other systems utilizing motion of the tube and of the film.

The author reproduces axial transverse stratigrams of patients with hydropneumopericardium and hilar adenopathy, as well as normal axial stratigrams at the level of the third cervical vertebra, the base of the skull, and the air-filled lateral ventricles.

The versatility of the apparatus employed is demonstrated by a complete roentgenographic study of a patient with pulmonary tuberculosis, including a standard roentgenogram, several ordinary stratigrams, and several axial transverse stratigrams.

Nineteen illustrations.

[Preceding this paper is a short background article by Professor Vallebona, briefly outlining the historical development of stratigraphy (pp. 769-776).]

CHRISTIAN V. CIMMINO, M.D.
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The Importance of Radiologic Control in Therapeutic Blocks. Manuel Morales Duclaud. Rev. mex. de radiol. 9: 313-320, November-December 1955. (In Spanish)

The infiltration of nervous channels is usually performed by referring to bony landmarks. Radiologic guidance will increase the accuracy, and thus the incidence of desired results. Added precision is required when, instead of procain and other short-acting analgesics, so-called neurolytic substances, such as carbolic acid 6 per cent, are injected. This series of 52 cases, of which 6 are briefly described, included diagnostic, prognostic, and therapeutic blocks of the stellate ganglion, of the suprascapular nerve in the supraspinous fossa, of the celiac and splanchnic, of the cervical, thoracic, and lumbar sympathetic, and of the trigeminal nerve.

The position of the needle is identified by appropriate roentgenograms; a single anteroposterior view often suffices, but lateral or oblique projections can be added if necessary. At times, especially in the case of

deep-seated sympathetic chains, it will appear desirable to inject a small amount of 35 per cent organic iodine compound to determine the exact location. This latter procedure could also be employed for investigat-

ing the diffusibility of a given volume of injected substance.

Four drawings.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

RADIOTHERAPY

Betatron Experiences in Bern. A. Zuppinger, with the collaboration of W. Minder, G. Poretti, H. R. Renfer, C. Tütsch, and A. Schreiber. *Radiol. clin.* **24**: 346-368, November 1955. (In German)

Biological studies and clinical experiences with the betatron at Bern are reported.

No difference was found in the lethal dose for *Escherichia coli* between conventional x-radiation and that from the betatron. The effect of 300 r on the Ehrlich ascites tumor was also the same with both types of radiation, but with smaller doses the betatron was more effective. Inhibition of root growth of *Vicia faba* was 25 per cent greater with conventional x-rays. For chick embryos the lethal effect was greater with conventional roentgen irradiation by over 30 per cent. For ascites tumor injected into the thigh, conventional radiation was also 30 per cent more effective.

In clinical practice, Zuppinger gives two daily treatments up to a total tumor dose of about 8,000 r. After the appearance of reactions, the single dose is decreased. Mucositis begins after about 4,000 to 6,000 r. Palliation is regarded as having been obtained only if the patient remains symptom-free for two months or in stationary condition for three months.

Of 26 patients with brain tumors, 8 were without symptoms for at least six months, and the survival period was longer than after conventional therapy. The dose was usually 10,000 r in thirty to fifty days. Of 26 patients with oropharyngeal-maxillary-pharyngeal tumors, 13 became symptomless and 4 were improved after a total dose of 6,000 to 9,000 r.

Five of 27 patients with esophageal carcinoma were alive after more than a year, without symptoms. The average dose was 9,100 r in thirty-three days. Cortisone therapy as a means of preventing fibrosis is considered hazardous; in 5 of 6 cases thus treated, perforation into the mediastinum occurred; in 14 cases in which cortisone was not used perforation ensued only once.

Of 24 patients with bronchial carcinomas, 11 died after an average survival of eight months. The survival in the other cases is too short for conclusions. The average dose was 8,790 r in forty-one days. Palliation was achieved in 13 of 19 gastric carcinomas, with an average survival of eleven months. The average radical tumor dose was 8,580 r in forty-five days.

Forty-eight cervical tumors were irradiated. Of 16 patients treated for post-radiation recurrence, 8 were symptomless for an average of eleven and a half months. However, several rectal and sigmoid complications developed, concurrent with further recurrence of the disease. Twenty patients received the routine radium treatment with additional betatron irradiation, but the periods of observation were short.

The impression is that the betatron represents significant progress in radiotherapy.

Fourteen illustrations; 5 tables.

LEWIS L. HAAS, M.D.
University of Illinois

Four Years Betatron Experience in Zürich. H. R. Schinz, H. Fritz-Niggli, and K. Schärer. *Radiol. clin.* **24**: 317-346, November 1955. (In German)

The 31 MEV betatron of Zurich emits two beams for irradiation, with a yield of approximately 15 to 30 r/min. While at 2 MEV the absorption by pair formation is only 1 per cent and by Compton effect 99 per cent, at 20 MEV there is 49 per cent absorption by pair formation, 50 per cent by Compton effect, and 1 per cent (insignificant) by nuclear processes. The stopping power relation of air and water is different for 200 kev and 31 MEV. The actual absorption in water (soft tissue) at 31 MEV is less than shown by ionization chambers of air-equivalent walls. The correction factor was found to be about 10 per cent by calculation, and about 4 per cent by actual measurements of Glocker and Breiting.

For quantitative comparison of the effects of various energies, clinical and biological experiments were performed with 180 kev and 31 MEV. However, the radiochemical method proved to be too crude and unreliable for such comparisons.

In biological experiments, the betatron always was less effective. As for the lethal dose, the difference in effectiveness was for *Escherichia coli* 8 per cent, for *Drosophila* eggs 25 per cent, for mice up to 50 per cent.

In mutation experiments with *Drosophila*, the effectiveness of the betatron vs. 180 kev was 0.6, in phenocopy experiments (imitated mutations) 0.8. A great number of other biological experiments are not completed. The betatron is quantitatively less effective for several reasons:

1. The true absorbed betatron energy is up to some 10 per cent less than shown by ionization measurements.
2. With the betatron, the ions are distributed homogeneously in the medium; at 180 kev they are in more concentrated clusters more widely separated.
3. The betatron radiation consists of 50 impulses per second, 10 microseconds per impulse. The 180-kev radiation is continuous.

It is still undetermined whether or not qualitative differences exist between the radiations of different energies.

Clinical advantages of betatron therapy are its greater penetration, saving of the skin, less general reactions, and decreased blood alterations. It is indicated for deep-seated tumors, in the presence of interposed bone, in selected cases of hypopharyngeal and laryngeal cancer, when it is necessary to treat through a single port, for recurrent or residual lesions, after 200-kev therapy, and for preoperative irradiation, to spare the skin.

Sixty-six cases of esophageal cancer were treated, with improvement in 15, lasting up to twenty-eight months; none were cured. Improvement was obtained in 17 of 37 bronchial carcinomas (no cures). Two of 27 patients with carcinoma of the bladder had remained symptom-free for two and a half years and 4 were improved. Of 35 cervical carcinomas, 15 received postoperative prophylactic irradiation; 5 of 16 in-

operable patients were without symptoms for six to twenty-seven months; in 4 recurrent cases the treatment was without effect. Eighteen of 25 cancers of the corpus uteri received postoperative prophylactic irradiation; 3 of 5 patients not undergoing radical surgery were relieved of symptoms for three to forty-two months. Of 19 patients with ovarian cancer, 10 received prophylactic irradiation; of 6 in whom radical operation was not done, 1 remained symptom-free after thirty-six months. Results in these advanced stages of disease are considered much better than with 200-kv therapy.

Twenty-nine illustrations. LEWIS L. HAAS, M.D.
University of Illinois

What Advantages Does Deep Therapy Give with Increase of Voltage from 200 kv to 250 kv? A. Schaal. *Strahlentherapie* 98: 332-338, October 1955. (In German)

The author discusses briefly the reasons for attempting to improve x-ray therapy by the use of increased voltages and relates the better results and advantages to the cost of procurement of a deep therapy unit. A unit of 250 kv was found to offer advantages over a 200-kv unit, with only moderate increase in cost, if used with increased filtration (2 mm. copper filter or Thorax filter) to obtain a half-value layer of 3 mm. copper. With such a half-value layer, the absorption in bone as compared with water is considerably less; the radiation is more homogeneous and an increased tumor dose is obtained. The degree of homogeneity amounts to 0.85 with 250 kv and a 3-mm. copper half-value layer as compared to 0.65 with 200 kv and a 1-mm. copper half-value layer. The tumor dose at the 10-cm. level is increased from 17 to 30 per cent.

Two photographs; 4 graphs.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Measurement of Continuous X-Ray Spectra with a Scintillation Spectrometer. D. V. Cormack, J. E. Till, G. F. Whitmore, and H. E. Johns. *Brit. J. Radiol.* 28: 605-609, November 1955.

The spectral distribution of x-rays may be determined by the use of a scintillation spectrometer. In this paper the method, instrument, and theory applied to measuring x-ray spectra by means of a scintillation crystal are described and the results obtained are compared to spectral distributions deduced from analyzing absorption curves.

A scintillation crystal emits a light pulse proportional to the photon energy it absorbs. The output light pulses from the crystal may be measured with a photomultiplier tube and suitable electronic equipment, giving the energy distribution of the incident photons. When smaller crystals are used, a large fraction of the incident energy escapes. The present investigators, therefore, employed a cylindrical crystal of sodium iodide 2 in. in diameter and 2 in. long, from which the loss of energy is small for photons up to 400 kev. Even so, the measured spectra required corrections allowing for photons which do not impart all of their energy in the crystal and other escape processes (Compton-scattered radiation, electrons which pass out of the crystal, and fluorescent x-rays produced in the crystal by photo-electric process in the iodine). An additional adjustment must be made for the statistical spread of pulse-heights from the photomultiplier.

These corrections can be made if one first knows the complete spectra of monochromatic radiation for a range of energy covering the measured spectrum.

The x-rays are directed through a series of diaphragmatic apertures to the thallium-activated sodium iodide crystal, which is housed in an assembly including a photomultiplier and pre-amplifiers. The output pulses from the photomultiplier are analyzed with a pulse-height analyzer. In order to plot a measured spectrum on an energy scale, one must determine the calibration curve of pulse-height as a function of energy. This may be obtained by the use of radioactive gamma emitters in which the pulse height is found to be a linear function of photon energy.

Measured spectra of primary 280-kvp radiation with half-value layers of 1.7 mm. copper, 2.5 mm. copper, and 3.1 mm. copper, respectively, are illustrated. A similar spectrum of 200-kvp x-rays filtered by 2.5 cm. lead is given. The characteristic radiation was estimated and the pulse distributions were subtracted from the measured distributions, so that smooth curves were obtained. Corrections for the escape processes and statistical spread were also made, and the corrected spectra are illustrated. Adjacent to these corrected curves are the spectra for comparable half-value layer radiation generated at 280 kvp, based on absorption measurements.

By comparing the continuous spectra of 280-kvp roentgen radiation as obtained with the scintillation method as opposed to the absorption method, it is concluded that the former is more direct, appears more reliable, and is particularly well suited to the measurement of spectral distribution in the 100- to 400-kvp range.

One diagram; 6 charts. JOHN W. WILSON, M.D.
University of Texas, Dallas

Combined Radiotherapy and Resection for Carcinoma of the Bronchus. Experiences with 66 Patients. L. L. Bromley and Leon Szur. *Lancet* 2: 937-941, Nov. 5, 1955.

A method of assessment was devised for patients with carcinoma of the bronchus attending a joint radiotherapeutic and surgical clinic. Of 732 patients who attended the clinic, 66 were given a course of radiotherapy followed by resection of the lung. Irradiation factors were 190 to 250 kv and a half-value layer of 2 mm. of copper. Treatment was based on multiple small fields, with careful beam direction; a coplanar field arrangement was employed. The tumor dose was from 3,700 to 6,000 r, the average being 4,700 r. The time taken to complete the treatment ranged from thirty-two to fifty days, with an average of about six weeks. Details of the surgical procedures are described, and the assessment of results includes an analysis according to the pathologic findings and the histologic changes after irradiation. The tumor was evidently eradicated from the chest in nearly half the cases, but the total results obtained did not show an overall improvement as compared with those generally reported.

While the combined treatment failed to produce impressive results, the following are considered features of interest: Irradiation evidently can "sterilize" a significant proportion of operable lung cancers. Contrary to some observers, patients were not unduly upset by planned and carefully fractionated therapy using small fields; constitutional effects were slight and

considerable improvement in the general condition of the patient was often noted. Fourteen patients originally classified as inoperable became operable and underwent pneumonectomy following irradiation. Although the results in the latter group were unsatisfactory, it is considered that the numbers involved are too few to justify any definite conclusions.

Drawbacks include the length of time involved in completing both phases of treatment and the high incidence of empyema and fistula following radiotherapy.

Two drawings; 9 tables.

Bronchogenic Carcinoma—a Five-Year Survey. J. W. McKay and M. N. Loughheed. *Canad. M. A. J.* 73: 815-818, Nov. 15, 1955.

One hundred and forty-five patients registered in the Montreal General Hospital Tumor Registry as having primary pulmonary carcinoma were studied over a five-year period. Eight patients were living at the end of the period. Of the 137 deaths, 45 occurred within a month of the time of diagnosis.

Radiotherapy was attempted only on those expected to survive a course of palliative radiation. Fifty-six patients were untreated. Their average survival was less than two months. Twenty-three patients received less than 3,000 r in four weeks, with an average survival of two and a half months. For the 27 patients who received complete radiotherapy (minimum 3,200 r in four weeks), the average survival was eight and a half months. The remainder received a combination of exploration, pneumonectomy, and/or radiation.

It is felt that the disease is radiosensitive but is too widespread when diagnosed for a high survival rate. Good palliation is to be expected with irradiation.

Six roentgenograms. RICHARD E. BUENGER, M.D.
Chicago, Ill.

Radiation Therapy Problems in the Diagnosis of Mediastinal Tumors. Franz Steinberger. *Strahlen-therapie* 98: 382-397, November 1955. (In German)

In former years mediastinal tumors were considered radiotherapeutic problems almost exclusively. With the ever increasing proficiency of thoracic surgery, however, more and more cases are now explored surgically. Nevertheless, Hodgkin's disease of the mediastinum has remained the domain of radiotherapy, since its radiosensitivity is well established and its diagnosis can frequently be verified by biopsy of peripheral nodes. In addition to the Hodgkin's group, other cases of malignant mediastinal tumors are still referred for radiotherapy because of inoperability.

The author's material, compiled from 1941 to 1953, consists of 124 cases, including 44 of Hodgkin's disease. Other conditions treated by high-voltage therapy are lymphosarcoma, retothel sarcoma, endothoracic and recurrent malignant goiters, and round-cell sarcoma. Ninety-eight cases were available for statistical evaluation.

Formerly, with the stationary roentgen tube a total dose of 4,000 r could rarely be tolerated. With rotational therapy, introduced in 1951, however, a depth dose of 5,000 to 6,000 r can now be given. This dose has been used in all malignant mediastinal tumors, with the exception of Hodgkin's disease, in which 4,000 to 5,000 r has been found sufficient. The width of the field has recently been extended to 6 cm. in the first part of a series so that the outer borders of extensive mediastinal masses could be reached by the edge

of the roentgen beam. For small tumors, however, the field has been kept as small as feasible. Treatment is begun with small single doses, 100 r daily, gradually increased to 200 r, consistent with the patient's tolerance.

The survival rate with rotational therapy cannot yet be properly evaluated because the follow-up has been too short, but in this brief period of observation the rate has been as good as with the older method of therapy. In 35 cases of Hodgkin's disease the average survival period has been thirty-eight months, while in 54 cases of malignant tumors it has been twenty-six months.

The author emphasizes preoperative roentgen therapy of all surgical cases.

Thirteen roentgenograms; 2 tables.

ERNEST KRAFT, M.D.
Newington, Conn.

Irradiation of Bladder Carcinoma by the Friedman-Lewis Technique. Grant Reid and C. A. Moore. *Canad. M. A. J.* 73: 796-800, Nov. 15, 1955.

Carcinoma of the bladder was treated by irradiation with 50 mg. of radium in two tubes suspended in a 30-c.c. Foley catheter bag, which was then distended with 4 per cent NaI to an outside diameter of approximately 4.2 cm. Two treatments at four or five day intervals were given. The total mucosal dose was 8,000 r. External radiation was given only in cases of extravascular extension of tumor.

Severe radiation cystitis was experienced by 8 of the 20 patients treated. Nearly all of these had advanced carcinoma. Only 1 of the 9 survivors has continued bladder discomfort. Insufficient time has elapsed to permit five-year survival analysis.

In the future the authors hope to improve their results by lowering the internal radiation dosage to 6,000-7,000 r; adding external or vaginal radiation; carrying pre-irradiation resection more deeply; waiting longer (four to six weeks) following resection before inserting radium; and performing ureterointestinal anastomosis in advanced cases.

Four tables. RICHARD E. BUENGER, M.D.
Chicago, Ill.

Irradiation Therapy in Hodgkin's Disease of the Thorax. Charles M. Nice, Jr., and K. Wilhelm Stenstrom. *Dis. of Chest* 28: 529-536, November 1955.

The authors present a series of 224 proved cases of Hodgkin's disease. The incidence of thoracic involvement was found to be high (64 per cent), in keeping with other series. All 28 cases coming to autopsy showed thoracic lesions.

The roentgen findings in Hodgkin's disease of the thorax include the presence of a mediastinal mass, consisting of groups of enlarged lymph nodes; pleural thickening or effusion or, rarely, cavitation or miliary pulmonary densities. Also, fistulous tracts may be formed.

Approach to therapy is related to the pathological concept of the process. An attempt is made to deliver at least 2,000 tumor r within fourteen days to disease localized to one or a few adjacent areas. When there is massive involvement of mediastinal nodes, small doses of 50 to 75 r in air are used initially to obviate possible edematous compression of the tracheobronchial tree. A total dose of 2,000 r is still given within three weeks. With widespread involvement, a tissue

dose of 1,000–1,500 r is administered to the larger masses for palliation. The authors found the clinical staging of Peters (Am. J. Roentgenol. 63: 299, 1950. Abst. in Radiology 56: 313, 1951) to be the best factor in correlating therapy and prognosis: Stage I, involvement of a single lymph node or region; Stage II, involvement of two or more proximal lymph node regions of either the upper or lower trunk; Stage III, involvement of two or more lymph node regions of both the upper and lower trunk.

For the 208 patients followed for five years, there was a 25 per cent survival; of the 167 followed ten years or longer, 11 per cent survived. The majority of the authors' cases were of Stage III; a much higher survival rate was obtained in Stages I and II. This was also the case when "survival following the first thoracic roentgen treatment" was tabulated.

It is concluded that intensive therapy, at least 2,000 r in two weeks, is indicated in Stage I and II cases. Palliative x-ray therapy and clinical agents such as nitrogen mustard and TEM should be used in Stage III, and may give much symptomatic relief.

Five roentgenograms.

LAWRENCE E. FETTERMAN, M.D.
Cleveland City Hospital

Combination of Irradiation and Sanamycin in the Treatment of Blood Dyscrasias. Dietrich Magnus and Karlheinz Zeitler. *Strahlentherapie* 98: 413–419, November 1955. (In German)

In order to improve the survival rate in blood dyscrasias, the authors treated 13 cases of lymphogranulomatosis and 13 cases of chronic leukosis with Sanamycin-Bayer (actinomycin C) in addition to the regular courses of high-voltage roentgen therapy. Sanamycin is a cytotoxic agent which is well tolerated and causes practically no side-effects. Single doses of 200 gammas of Sanamycin were given intravenously five times per week until a total dose of 5,000 to 8,000 gammas was reached.

Subjective improvement was observed in almost all cases. The success of the treatment cannot be properly evaluated as yet because the follow-up period of eighteen months is considered too short. It is believed, however, that in Hodgkin's disease Sanamycin medication helps to prolong periods of remission following deep roentgen therapy.

ERNEST KRAFT, M.D.
Newington, Conn.

Roentgen Therapy of Hypophyseal-Hypothalamic Region in Malignant Exophthalmos. W. Legrèze. *Strahlentherapie* 98: 423–429, November 1955. (In German)

Malignant exophthalmos has increased in frequency since the introduction of thyrostatic medication, especially thiouracil. Even radioiodine in overdoses is known to produce malignant exophthalmos secondary to induced hypothyroidism and myxedema. The author differentiates between (1) hyperthyroid exophthalmos with absence of palpebral edema and with good response to thyrostatic therapy and (2) malignant exophthalmos. In the latter condition the eyeball is hard, and there are pain, palpebral edema, and frequently ulcerative keratitis and diplopia; also there is no response to thyrostatic therapy. During treatment of goiter a hyperthyroid exophthalmos may change to a malignant exophthalmos without intermittent regression.

In animal experiments it has been shown that malignant exophthalmos cannot be produced by administration of thyroid hormone but only by the thyrotropic hormone of the anterior pituitary lobe. The hypophysis receives the impulse for secretion of thyrotropic hormone from the thyroxin level in the blood. When this level falls off, as in hypothyroid conditions, the hypophysis will secrete more thyrotropic hormone in order to stimulate the synthesis of thyroxin in the thyroid gland. When the thyroxin production has come to an end, however, the pituitary stimulus becomes ineffective. As a result of the interrupted physiologic mechanism, the retrobulbar tissues become the site of serous inflammation which leads to the syndrome of a malignant exophthalmos.

Therapy has to be started early, otherwise the edema will give place to retrobulbar induration, and the condition will become resistant to treatment, with development of corneal ulcers, papillary edema, and secondary amblyopia or amaurosis.

The pituitary gland is known to be fairly radioresistant, but in thyrotropic dysfunction it can be influenced by relatively small doses of roentgen rays, like the paraventricular and supraocular centers in the hypothalamus.

The author has treated only the early stages of malignant exophthalmos; therefore, his results have been favorable and the associated eye pain has in most cases become milder after the first treatment.

Both temporal fields were used for high-voltage therapy, the size of the fields being 6 × 8 cm. so as to include the retrobulbar tissues. In addition, a frontal field was used for pituitary irradiation only. Treatments were given until a total skin dose of 2,000 to 3,000 r was reached. In resistant cases a second series was instituted after a lapse of two or three months.

The success of radiotherapy in the early stage is believed to be due to inhibition of the specific thyrotropic hormone secretion in the hypophysis and, in part, to the effect on the inflamed retrobulbar tissues.

ERNEST KRAFT, M.D.
Newington, Conn.

Roentgen Therapy of Subdeltoid Tendinitis and Bursitis. Analysis of 159 Cases Treated with Intermediate Radiation Therapy. M. Shoss and T. G. Otto. *Missouri Med.* 52: 855–863, November 1955.

A report is made of 159 followed cases of subdeltoid tendinitis and bursitis treated by intermediate-voltage roentgen therapy. A description is given of the anatomy of the shoulder joint together with a brief discussion of the etiology, pathology, and diagnosis of the disease. Diagnosis was made on clinical or radiological findings, or both. Two-thirds of the cases showed soft-tissue calcification in the subdeltoid region. Only a few patients gave a definite history of injury. The radiotherapeutic technic is similar to that usually employed: 0.5 mm. Cu h.v.l., daily treatments of 150 r (air) to alternate anterior and posterior fields for a total dosage of 450 r (air) to each of the two ports. This was considered a complete course, and no further radiotherapy was given in the majority of cases.

For evaluating the results of treatment, the cases are subdivided into two approximately equal groups: acute, with sudden onset of pain within the past ten days; chronic, with pain for more than ten days, usually associated with limitation of motion. Of the patients

with acute disease, 75 per cent had no residual pain and 20 per cent were improved but still had occasional symptoms. In the chronic group, one-half had no pain and an additional one-third were improved but still had occasional symptoms. Thus, of the total group, 92 per cent are considered to have had complete remission or definite improvement. Further analysis indicates that in the patients with acute symptoms slightly better results were obtained than in those with chronic bursitis, but the difference was not striking. Patients with fine, milky, peri-articular calcification obtained considerably better relief than those without calcification. Shoulders showing dense, hard, bony, calcific soft-tissue masses seldom responded well to radiotherapy, and the authors feel that surgery is the treatment of choice in this small group.

In the acute group satisfactory remission was obtained in one week in half of the cases and within three weeks in 70 per cent. In the chronic group relief was experienced in the first week in only 15 per cent and within the first three weeks in 40 per cent. After six months, more than 70 per cent were relieved. The few cases (8 per cent) considered failures were further analyzed and no reason for the poor results could be determined.

The authors feel, after reviewing the literature and tabulating their own experience, that conservative roentgen therapy offers the most satisfactory and rapid method yet available for management of calcific bursitis and tendinitis of the shoulder.

Twelve tables. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

RADIOISOTOPES

Methods and Indication for Therapy with Radioactive Isotopes. A. Jakob and J. Hiller. *Strahlentherapie* 98: 284-290, October 1955. (In German)

The authors discuss both the local and interstitial application of radioisotopes. For local application they use radiocobalt (Co^{60}), radio-iridium (Ir^{192}), radio-yttrium (Y^{90}), and radiophosphorus (P^{32}).

Radiocobalt is used in the form of small pellets in a plastic mass (Makrohalt) or as cobalt pearls, cobalt wire, and cobalt chloride solution. Makrohalt is used for larger skin lesions, such as breast metastases, cancers of the lip and antrum, and nasopharyngeal carcinomas. It has also been employed for carcinoma of the vagina. The dose for skin lesions is 1,200 r per square centimeter for a field of 30 to 40 square centimeters. The dosage for sinus neoplasms is 5,000 to 7,000 r in one sitting (after partial surgical removal), followed by an additional 3,000 r two months later. The dose for vaginal cancer is 8,000 to 10,000 r. Radiocobalt and cobalt-60 chloride in solution have been used for bladder carcinoma. A surface dose of 7,000 r was obtained with such treatment.

Carcinomas of the cervix and uterus have been treated with radio-iridium with less damage to the bladder and rectum than is caused by radium.

Radio-yttrium has been used for hemangioma, neoplasms of the eye, hyperkeratoses of the skin, and for warts and keloids. The dosage for hemangiomas in infants is 3,000 to 6,000 rep in divided doses of about 1,000 rep per application.

Radiophosphorus has been employed locally for hemangiomas and superficial skin carcinomas, since its maximum penetration is only 7 mm.

For interstitial application, radiocobalt, radiotantalum, radiogold, and radiobismuth have been employed. Radiotantalum, mainly in the form of wire, has been used for neoplasms of the tongue, lip, mucous membranes, and bladder, and for peri-anal and vulvar neoplasms. The dosage for the vulva and bladder is about 7,000 r in five to seven days.

Radiogold has proved effective for pleural effusions and ascites, in doses of 100 to 200 millicuries for the pleura and 200 to 400 millicuries for the peritoneum.

Colloidal radiogold has been given intravenously for myelogenous leukemia. The dosage in such cases has been 30 to 60 millicuries. It has not proved useful in lymphatic leukemia.

Solutions of radiobismuth have been injected directly in Hodgkin's disease and lymphatic leukemia.

The authors stress the advantages of radioactive isotopes over radium and other forms of irradiation, because of the several possible methods of application (local, interstitial, intravenous).

Two tables. JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Treatment of Thyrotoxicosis with Radioactive Iodine. Review of 140 Cases. G. M. Blomfield, J. C. Jones, H. Miller, A. G. MacGregor, E. J. Wayne, and R. S. Weetch. *Brit. M. J.* 2: 1223-1229, Nov. 19, 1955.

This paper presents a review of 140 cases of thyrotoxicosis treated with radioiodine and followed closely for at least one year. In each patient an attempt was made to deliver 6,000 to 8,000 rads (1 rad = 100 ergs per gram of tissue) in one therapeutic drink. The dose was calculated on the basis of the iodine uptake tracer study, effective half-life, and volume of the thyroid. The usual indications for radioiodine were followed in the selection of cases, but because of the undetermined carcinogenic properties of the radioactive material, treatment was restricted to patients with twenty years or less life expectancy.

Of the entire group of 140 patients, 118 (84 per cent) became euthyroid. Eighty-seven of these were successfully cured with one drink, 25 required two drinks, and 6 required three or more doses. The average interval between treatment and establishment of euthyroidism for single-dose cures was approximately four and a half months. Seventeen patients (12 per cent) became hypothyroid, 15 of whom had only one drink, while 1 had two treatments and 1 had three treatments. The average interval for the development of hypothyroidism was eight months, with a range of three months to three years. In only a few instances was the full syndrome of myxedema observed. At the time chosen for the assessment of results, 4 patients were still toxic. One of these declined further treatment because she felt well; the other 3 were subsequently re-treated and became euthyroid. An analysis of the failure rates demonstrated a relationship to the dose except within the limits of 6,000 and 11,000 rads, in which no significant difference was obtained. There was a higher failure rate in patients with large glands

and with higher blood PBI^{131} concentrations. It was also found that the failure rate was higher in nodular goiters, indicating that the dosage rate should be higher than would be judged necessary from the size of the gland alone.

In every case of thyroid gland enlargement, there was a decrease in size following iodine therapy. The diffusely enlarged glands returned to normal and the nodular enlargements were reduced. Exophthalmos improved considerably in many patients, and in no case did it become worse. Subsequent to the time of assessment, however, 2 patients showed a progression of exophthalmos after otherwise successful treatment with the isotope.

Aside from hypothyroidism, the principal complications to radioiodine therapy involved "rheumatic" manifestations. Fifteen patients complained of "rheumatic" symptoms, either articular or non-articular. In 2 patients rheumatoid-like arthritis developed. In 1 this was well controlled with aspirin and there was no residual disability. In the second there has been a prolonged course of two and a half years, with steady improvement and increasing functional capacity. Four patients had symptoms of osteoarthritic lesions involving a single larger joint. The most common complaint after therapy was a non-articular "rheumatism" involving principally the neck and shoulder girdle. In no instance was it of more than average severity, occurring about four to six weeks after therapy, and in each case recovery was complete.

The carcinogenesis of ionizing radiation in the thyroid gland has not been evaluated, although it has been employed for fifteen years without a reported case of thyroid cancer. Only in experimental animals has the production of thyroid carcinoma been observed. In these the doses were enormous in comparison to the therapeutic doses used in man, and in no instance did carcinoma develop from the use of the isotope alone (*i.e.*, without an additional stimulating factor).

The 12 per cent incidence of hypothyroidism is relatively high and could be traced in some cases (those treated earlier in the series) to overtreatment. The authors cite the work of Greene (Memoirs of the Society of Endocrinology. No. 1, The Thyroid Gland, Pittman Press, Bath, 1953), who has demonstrated in post-thyroidectomy patients a close correlation between postoperative hypothyroidism and the presence of lymphadenoid changes in the resected gland. Since no direct relationship of hypothyroidism to the amount of gland left behind has been determined, it is reasoned that the occurrence of hypothyroidism is based upon the functional capacity, not the volume, of the remaining gland, which in turn depends upon the degree of lymphadenoid involvement. It would seem probable, therefore, that a certain basic incidence of post-therapeutic hypothyroidism is inevitable. This incidence will increase with the age of the patients treated.

On the basis of their experiences, the authors have revised their dosage prescription and now aim to give 7,000 rads for diffusely enlarged glands with 5,000 to 7,000 rads for smaller glands. For large and multinodular glands, 8,000 rads or more are prescribed, and for those in which a high PBI^{131} is shown after the tracer study the dose may be higher. There is a tendency to give a greater dose in elderly and more severely toxic patients and in those with severe cardiac involvement. It is believed that the revisions of dosage will

enhance the efficacy of this therapeutic regimen and reduce the complication of hypothyroidism.

Six tables; 1 graph. JOHN W. WILSON, M.D.
University of Texas, Dallas

Radioactive Iodine or Surgery in Treatment of Hyperthyroidism. Dwight E. Clark and James H. Rule. J.A.M.A. 159: 995-997, Nov. 5, 1955.

From the authors' experience with 700 patients treated with radioactive iodine for thyroid disease, the following criteria are listed as indications for this form of therapy: (1) uncomplicated hyperthyroidism in patients over forty years of age; (2) recurrent or persistent hyperthyroidism after thyroidectomy; (3) hyperthyroidism with severe cardiovascular disease or some other concurrent disease; (4) failure to respond properly to antithyroid drugs; (5) refusal of surgery; (6) presence of severe exophthalmos. Contraindications are (1) pregnancy or lactation; (2) clinical solitary nodule associated with hyperthyroidism; (3) non-toxic nodular goiter; (4) non-toxic diffuse or simple goiter. The authors also advise against treatment of children with toxic goiter because of the yet undetermined risk of carcinogenesis. They have even been reluctant to give children small tracer doses of I^{131} for thyroid function studies.

In a series of 628 fully evaluated patients, 83 per cent became euthyroid, in 17 per cent some degree of hypometabolism developed, and approximately 0.5 per cent showed recurrent hyperthyroidism following treatment. The authors point out that the degree of hypometabolism was usually very mild and in many cases was transient. For 82 per cent of the patients one or two doses of radioactive iodine were sufficient, but there was a small group which required three or more doses before satisfactory remission was obtained. There were no serious side effects; in most instances the reactions were almost negligible.

One hundred and eighty-nine patients had exophthalmos of varying degree. In no instance did this become worse following iodine therapy. In more than a third of the patients it regressed completely and over half of the remainder showed varying degrees of improvement. In only 10 per cent was the degree of exophthalmos unchanged. The authors feel that these statistics indicate better improvement in exophthalmos than can be expected from surgery.

The conclusion is that radioactive iodine is an excellent means of treatment in selected cases of thyrotoxicosis and that it offers many advantages over surgery.

One photograph; 3 tables.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Childhood Thyroid Carcinoma: Pathologic Considerations and Their Therapeutic Implications. J. A. Buckwalter. J. Clin. Endocrinol. & Metab. 15: 1437-1452, November 1955.

Of 79 patients with thyroid cancer seen in a period of five years, 8 were less than fifteen years of age. Three of the 8 had had irradiation in infancy for an enlarged thymus.

Seven of the 8 patients had follicular or papillary adenocarcinoma (4 of the 7 showed both characteristics but one pattern or the other predominated). All 7 were living at the time of this report: 1 five years, 4 between two and three years, and the other 2 less than

one year. The single fatality was due to a small-cell undifferentiated carcinoma.

Surgical treatment varied from subtotal removal to total thyroidectomy and radical neck dissection. In all but 2 cases (including the fatal case) I^{131} was used postoperatively. In the patient surviving five years pulmonary metastases were present but disappeared after treatment with I^{131} . The small-cell carcinoma was treated with external roentgen radiation, with practically no response.

[Even a five-year survival means little in respect to cure in thyroid carcinoma, but the results indicate that thyroid cancer in children is quite responsive to I^{131} therapy, except for undifferentiated lesions. The surprising incidence (8 out of 79) behooves us to think of this lesion more often in the presence of a mass in the neck in childhood.—Z. F. E.]

Two roentgenograms; 3 photographs; 11 photomicrographs; 1 drawing. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Triiodothyronine in the Serum of Patients Treated with Radioactive Iodine. Richard S. Benua, Brown M. Dobyns, and Anne Nimmer. *J. Clin. Endocrinol. & Metab.* 15: 1367-1378, November 1955.

Chromatographic studies of the serum were made in 52 patients after administration of I^{131} . The series included 39 patients with Graves' disease, 2 with hyperfunctioning thyroid adenomas, 4 with remnants of thyroid tissue after cancer surgery, and 7 with presumably normal thyroids with heart disease.

Triiodothyronine was identified in 27 patients, usually in greater amounts in those with hyperfunctioning tissue. It could be identified when it constituted as little 1 per cent of the circulating I^{131} . From the time of its appearance (as early as one hour after administration) and the fairly constant level, the authors conclude that it is not a product of radiation damage, nor of peripheral de-iodination of thyroxine, but is released into the circulation from the thyroid gland.

Four tables; 6 graphs. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Diagnostic Accuracy of Serum Protein-Bound Iodine Determination in Thyroid Disease. Charles M. Blackburn and Marschelle H. Power. *J. Clin. Endocrinol. & Metab.* 15: 1379-1392, November 1955.

A very thorough study of the value of the serum PBI values was done in 1,542 patients at the Mayo Clinic with normal and abnormal thyroids. Comparison was made with the basal metabolism rate and radioiodine uptake for relative accuracy. The PBI test proved to be consistently the most accurate measure of thyroid normalcy, although not accurate enough to justify recommendation of its use to the exclusion of the other tests. In equivocal cases the authors believe that all three tests should be used for a correct diagnosis.

Ten tables; 2 graphs. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The Excretion of Radioactive Iodine in Human Milk. H. Miller and R. S. Weetch. *Lancet* 2: 1013, Nov. 12, 1955.

A case is presented which indicates that I^{131} is concentrated in human milk to such a degree that even a dose as small as 25 μ c may have an adverse effect upon

the infant's thyroid gland. The concentration of I^{131} activity in breast milk was found to be considerably greater than that in the plasma at about the same time. It is concluded that radioactive iodine should not be given to a nursing mother; if a dose is administered, breast-feeding should be immediately discontinued.

One table.

The Use of Radioactive Iodine in the Treatment of Chronic Pulmonary Insufficiency. B. Shannon Galaher, William F. Hamilton, Jr., Irene F. LaMotte, Robert G. Ellison, Lois Ellison, and W. F. Hamilton. *J.M.A. Georgia* 44: 515-517, November 1955.

Treatment of chronic pulmonary insufficiency with radioactive iodine relieves distress by reducing the demand for oxygen. The handicapped lungs are called upon for lessened gaseous exchange activity or a lower work load. Maximum breathing capacity, vital capacity, and other tests of ventilatory capacity showed no change following iodine treatment.

Radioactive iodine was used in 16 patients, all of whom had been pulmonary cripples for months to years. Six had severe asthma, 1 had silicosis, 1 senile emphysema, 1 bullous emphysema, 3 cor pulmonale from pulmonary valve disease, 2 tuberculosis. All had received the various standard forms of treatment without relief. The dose of I^{131} was 15 to 26 mc without carrier, with retreatment after two months when necessary.

Excellent results were obtained in 4 patients, good in 4, and fair in 4. One responded poorly and 3 were not improved at all. No radiation sickness, depression of bone marrow, or toxic effects on blood or kidneys was noted. In no instance did hypothyroidism develop.

The severely incapacitated individual who is also severely hypothyroid derives little benefit from this procedure. The hyperthyroid patient would be expected to benefit in spite of severe insufficiency. The euthyroid patient can be helped over a considerable handicap.

D. DEF. BAUER, M.D.
Coos Bay, Ore.

Volume of Irrigating Fluid Transfer During Transurethral Prostatectomy, Studied with Radioisotopes. Miles Griffin, Lowry Dobson, and John C. Weaver. *J. Urol.* 74: 646-651, November 1955.

The authors studied the transfer of irrigating fluid into the patient's blood stream during prostatectomy by the use of radioactive tracers. Volumetric measurement of irrigating fluid transferred during transurethral resection by means of closed irrigating system was compared to NaI^{131} transfer measurements in 3 patients and I^{131} albumin transfer in 4 patients.

The close relationships of the volumetric and NaI^{131} measurements and differences in volumetric and I^{131} albumin measurements indicate that volumes as high as 3,000 c.c. may be transferred and that this may occur both extravascularly and by way of open vessels.

Two tables; 1 graph.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Radiophosphorus in the Treatment of Capillary Naevi. D. S. Anderson Roe, Christine Hodges, G. S. Innes, and L. I. Pope. *Lancet* 2: 1111-1113, Nov. 26, 1955.

P^{32} beta-ray plaques have proved useful in the treatment of superficial vascular nevi, including capillary

nevi. The authors describe a technic for construction of such plaques so that they are easy to handle and can be shaped to fit into cavities and over protuberances. They may be made large or small as required. Loaded to a density of 266 μC of P^{32} per square centimeter of surface, the plaques give an output of 1,000 r per hour. They should not be used in treatment of lesions more than 1 mm. thick. If lesions on the eyelids are to be irradiated, the eyes must be protected.

Doses up to 3×450 r given to a nevus flammeus as large as 200 sq. cm. produced fading of the lesion without any severe skin reactions. More time is required to demonstrate whether late skin changes will occur as a result of this dose, but none had been observed two years following treatment.

Six photographs; 1 drawing; 1 graph.

Kilocurie Revolving Cobalt-60 Unit for Radiation Therapy. L. H. Lanzl, D. D. Davison, and W. J. Raine. *Am. J. Roentgenol.* **74**: 898-916, November 1955.

This is a presentation of the design and construction features of a cobalt-60 revolving therapy unit which has been built and is in operation at the Argonne Cancer Research Hospital at the University of Chicago. For descriptive purposes the several component parts of the unit are considered separately: (1) the cobalt-60 source, (2) the main shield, including the source shutter, light localizer, and collimating system, (3) the large rings which support the shield, (4) the drive mechanism by which the shield is moved around the patient, and (5) the control console.

The unit was designed to hold a source of 1,750 curies although it could accommodate a unit of twice that strength. The source shield revolves either completely or in sectors about a recumbent patient. In addition, the shield itself can be angulated. The distance from the source to the center of revolution is fixed at 81.6 cm. The treatment cot is aligned by means of one rotational and three linear motions. Rectangular and square field shapes up to 15×15 cm. may be used. It is interesting to note that the shield for the cobalt source is constructed of uranium. A diagram of the room layout and protective barriers is given.

Twenty illustrations. WYNTON H. CARROLL, M.D.
Shreveport, La.

Clinical Application of Cobalt⁶⁰-Labeled Vitamin B₁₂ Urine Test. Melvin I. Klayman and Lloyd Brandborg. *New England J. Med.* **253**: 808-812, Nov. 10, 1955.

The authors studied a diverse group of 37 patients likely to yield informative results following the oral administration of water containing vitamin B₁₂ labeled with radiocobalt. The urine output was collected for twenty-four hours and the activity determined in one of two ways. For the "direct" method of counting, 2-c.c. and 4-c.c. samples of urine were placed in a well-type scintillation counter for five minutes. The authors modification of this technic was to concentrate the twenty-four-hour urine volume to less than 200 c.c. by rapid evaporation and count for thirty minutes. With the latter method, samples of 2 and 4 c.c. yielded a standard error of less than 1 per cent, while in the direct method, the error was in the neighborhood of 10 per cent.

Radioactivity recovered in the twenty-four-hour

urine appears to be dependent on the presence of intrinsic factor in the stomach, which permits absorption of the labeled vitamin. In 3 normal subjects the percentage of recovered radioactivity ranged from 7.9 to 12.0 per cent. In 7 patients with pernicious anemia the urine radioactivity was less than 1 per cent. When one of this latter group was given 5 mg. of intrinsic factor with the test drink, the absorption of the radiocobalt-B₁₂ was enhanced and the excretion in the urine reached a normal level.

Other patients studied were 2 with megaloblastic anemia other than pernicious anemia; 2 with dorso-lateral spinal neuropathy; 13 with achlorhydria; 4 with gastric carcinoma; 5 who had undergone gastric resection; 1 with a fish tapeworm. In the patients with carcinoma and those with varying degrees of resection, the ability to excrete the radiocobalt appears to depend on the integrity of at least a portion of the intrinsic-factor-producing cells which make absorption possible. The results in some of the other syndromes is not clear cut, and further experience must be gained before the limitations of the test can be overcome in clinical practice.

One table.

SAUL SCHEFF, M.D.
Boston, Mass.

Uptake of Radioactive Vitamin B₁₂ by the Liver in Patients with Total and Subtotal Gastrectomy. George B. Jerzy Glass, George T. Pack, and Walter L. Mersheimer, with technical assistance of Jane Kusnick and Roger Laughton. *Gastroenterology* **29**: 666-682, October 1955.

Hepatic uptake of radioactive Co⁶⁰ containing vitamin B₁₂ was measured in 8 patients after subtotal and in 8 patients after total gastrectomy. The measurements were made following administration of a standard dose of Co⁶⁰-B₁₂ alone and also following administration of Co⁶⁰-B₁₂ with preparations of the intrinsic factor.

These studies showed no hepatic uptake of the Co⁶⁰-B₁₂ in patients with a total gastrectomy, indicating a lack of intestinal absorption of B₁₂. This absorption defect could be partially corrected by adding the intrinsic factor concentrate, with intestinal absorption of 20 to 40 per cent of B₁₂, using parenteral absorption as a base line of 100 per cent.

The patients with subtotal gastrectomy exhibited hepatic uptake of the Co⁶⁰-B₁₂, but at a level below normal. Improvement in the rate of absorption of B₁₂ was sometimes evident after administration of the concentrated preparations of the intrinsic factor.

Prolonged storage of vitamin B₁₂ in the liver was indicated by the persistence of radioactivity following administration of a single dose of Co⁶⁰-B₁₂.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Hepatic Radioautography Following Intravenous Injection of Radioactive Chromium Phosphate as a Further Contribution to Reticulo-Endothelial Functional Tests. Elemér R. Gabrieli, Dieran Goulian, and John L. Cutler. *Yale J. Biol. & Med.* **28**: 63-71, September 1955.

Radioautograms following intravenous injection of CrP⁵²O₄ were used in the study of reticuloendothelial function. Routine functional studies included (a) the determination of the phagocytic activity of the total reticuloendothelial system, (b) the determination of the site of uptake of the test colloid, and (c) the phagocytic

capacity of the reticuloendothelial system. The technical procedures and interpretation of the hepatic radioautograms are outlined in this paper.

Radioautographs of liver sections from healthy animals showed a very regular pattern with Kupffer cells containing radioactive particles located peripherally along the interstitial septum between the lobuli. A markedly distorted pattern was observed in infectious conditions of the liver. Whole-body x-irradiation ranging from 100 to 500 r also caused varying degrees of distortion of the reticuloendothelial pattern in the hepatic radioautograms. Attempts to evaluate the radioautograms by the Odeblad densometric technic were disappointing. Two other semiquantitating methods gave better results.

The authors believe it is necessary to qualify a reticuloendothelial functional test by checking, with radioautography or regular histology, the hepatic localization of the injected colloid. The peripheral Kupffer cells are apparently very radioresponsive, cortisone-sensitive, and certainly involved in the immune response.

Twelve illustrations.

WANG YEN, M.D.

Mercy Hospital, Pittsburgh

Medical Scintillation Spectrometry. J. E. Francis, P. R. Bell, and C. C. Harris. *Nucleonics* 13: 82-88, November 1955.

This article describes a new spectrometer circuit developed at the Oak Ridge National Laboratory by the authors. This circuit is specifically designed for scintillation counting of gamma rays, such as those emitted

by various radioactive isotopes used in medicine. Pulse height analysis makes it possible to discriminate against scattered gamma rays and to count only those proceeding directly from the source. Complete circuit diagrams are provided for the linear amplifier, single channel analyzer, data storage and recording, and the power supply. Typical spectra obtained with the gamma rays from chromium 51, iodine 131, and cesium 137 are shown as measured under different conditions to demonstrate the performance of the spectrometer. The use of this spectrometer for the simultaneous determination of the amount of two radioactive isotopes present in a sample, as chromium and iodine in a blood sample, is also demonstrated.

In addition, two collimators have been developed which can be used with this spectrometer for specific purposes. The first is a flat field collimator designed for thyroid uptake studies. It accepts radiation only from a 30° arc. A second collimator is described with 19 tapering hexagonal holes in a 2-inch lead shield. The axes of the holes meet at a point 2 inches from the face of the collimator. This collimator is referred to as a "focusing" type and its use is demonstrated with a mock thyroid gland. A tracing of the contour of activity obtained illustrates the ability of the collimator to detect hot spots and voids with good precision. The entire apparatus, including the circuit and collimators, is compact and specifically designed for medical radioactive isotope applications.

Fourteen figures.

JOHN S. LAUGHLIN, Ph.D.

Memorial Center, New York

RADIATION EFFECTS; PROTECTION

The Radiation Protection Problem in Diagnostic Roentgenology. G. Spiegler. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 83: 650-660, November 1955. (In German)

The incidence of inadequate radiation protection is difficult to estimate, because available data come from surveyed institutions, which seldom condone carelessness or ignorance. Overexposures are probably as frequent in diagnostic as in therapeutic roentgenology. This paper reports measurements of stray radiation during diagnostic procedures at the Royal Cancer Hospital in London, the physics department of which is under the direction of Professor Mayneord.

Two main problems were investigated. The first concerns the distribution of scatter emitted by the patient's body. The values were calculated in mr/r_0 , i.e., milliroentgens for every roentgen of primary radiation which reaches the patient (phantom). Important differences were observed between the scatter formed when the cross section of the beam was entirely covered by the object (as it should be when the diaphragm is correctly manipulated during fluoroscopy) and the more abundant secondary radiation produced when the beam extended beyond the margins of the part examined (as almost always occurs during roentgenography). The maximum dosages were 15 mr/r_0 as opposed to 35 mr/r_0 , measured on a plane (parallel to the 80-kv beam) 20 cm. away from the elliptic phantom, the irradiated field having a diameter of 24 cm. These figures should be brought to the attention of urologists (and others who use over-the-table tubes), but are of even more significance in under-the-table fluoroscopy (including, of course, barium enema examinations, myelography,

and cardiac catheterization). In the case of fluoroscopy the addition of a long cone may attenuate the emitted scatter by as much as one-half its value.

Planes perpendicular to the beam were also explored. While there is a very steep fall-off from the center toward the periphery at the level where the beam reaches the skin, conditions are quite different about the exit surface, which explains the relatively large amount of scatter received by "visiting observers." Added 1.0 mm Al filtration results in as much as 60 to 70 per cent overall reduction of scatter.

The second question concerns the existence of "tertiary" radiation, emitted by walls, ceiling, floor, and any protecting lead or lead-glass surfaces. Comparative anterior and posterior chest-wall badge monitoring on 6 technicians for two-week periods revealed the amounts of radiation received on the back (the anterior dose taken as 100) to be 15 per cent, 20 per cent, 4 per cent, 25 per cent, 50 per cent, and 30 per cent. These figures are indeed significant, even though permissible exposures were not exceeded. In this respect, it may perhaps be necessary to change some of our concepts. It seems that the fluoroscopist (or technician) works in a "cloud" of soft-scatter total-body radiation in addition to the primary and secondary radiation which comes from the roentgen tube. Substances of medium atomic weight (brick, concrete, iron, steel) apparently produce less tertiary scatter than those of high (lead) or low (wood) atomic weight. Wooden surfaces exposed to the beam should be covered by 1.0 mm. aluminum or iron plates.

Six diagrams.

E. R. N. GRIGG, M.D.

Cook County Hospital, Chicago

Radiation Doses to the Gonads in Diagnostic Radiology and Their Relation to the Long-Term Genetic Hazard. J. H. Martin. M. J. Australia 2: 806-810, Nov. 12, 1955.

Radiation results merely in a speeding up of the spontaneous mutation rate and not in the production of any qualitative differences. An increase in the mutation rate must be considered undesirable for man, as well as for other species. At the present state of our knowledge, we can expect that radiation reaching the gonads will increase the frequency of all the distressing hereditary conditions now apparent. The danger is growing, as an ever-increasing proportion of the population is being exposed to radiation, both occupationally and in medical diagnosis. This paper reports a detailed analysis of extensive data by a physicist in an attempt to assess the radiation contribution to the gene material of the population incident to diagnostic radiography.

Measurements were taken by placing an ionization chamber in contact with the scrotum of the male and an ionization chamber in the posterior fornix in the female whenever this was possible. In the majority of female patients, however, measurements were made by placing the chamber over the area of the ovary on the skin surface closest to the x-ray tube. From these latter measurements estimates of the actual dosage to the ovaries were calculated. Two rather complete tables of various diagnostic procedures list the average doses delivered to the male and female gonads. The frequency of various examinations is also tabulated. From these studies it is shown that, in males, about one-third of the total dose is received during examination of the stomach, but this accounts for only 8.3 per cent of the total number of people concerned. This examination, together with the examination of the pelvis and hips, accounts for over 70 per cent of the dose received, but represents only some 14 per cent of the cases. These figures are calculated on a total accumulated dose over a thirty-year period. For the females, some 50 per cent of the total gonadal dose comes from three types of examination: salpingography, roentgenography of the lumbosacral joint, and excretion pyelography. This, however, represents only about 6 per cent of total cases. For both sexes the number of chest examinations is large, but they give rise to a very small proportion of the gonad dose. It is estimated that fluoroscopy contributes approximately 3 per cent of the total dosage.

Obviously, the gonad dose per examination will be higher in children, but this is offset by the comparative rarity of the types of examination giving rise to the highest doses in this age group. It has been estimated by others that the fetus receives 3 r per pelvimetry or pregnancy examination. In addition to diagnostic x-ray examinations, the population receives daily radiation due to cosmic rays and radioactive material in the ground. Over a thirty-year period this may amount to about 3 r per person.

The author has estimated that from current evidence on hand the increase in the mutation rate determined by his studies of the Australian population would result in an increase of only 0.5 per cent, which need not be a cause for alarm. However, any increase in the hazard to the future of the race is more likely to arise from the increased use of diagnostic x-ray examination than from an increase due to occupational exposure. Particular care must be taken, therefore, in carrying out

x-ray examinations, especially those which involve large doses to the gonads.

The author goes on to discuss the various factors affecting dosage to the gonads in x-ray examinations. He recommends the use of a scrotum shield and increasing tube filtration and kilovoltage. While a substantial reduction in skin dose, and in gonad dose when the gonads are in the beam, can be achieved with higher kilovoltage, it is pertinent to note that when the gonads are outside the direct beam the dose reaching them may be high, as the amount of scatter rises appreciably with increased kilovoltage.

Muller has stated that with certain reservations modern civilized society can tolerate a 20 r dose increment per generation. Although the statistics of this paper show that the average per capita dose in Australia does not approach this figure, there are indications that it is being approached in the United States.

Four tables.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Radiation Protection of the Germ Plasm in Diagnosis. P. L. T. Ilbery and B. W. Scott. M. J. Australia 2: 885-886, Nov. 26, 1955.

It frequently happens in roentgen diagnosis that the gonads are irradiated for no other reason than that they lie in the field being examined. In this study the authors attempt to evaluate the sequelae of this unnecessary exposure. The dose received by the testis in certain examinations is recorded.

Although it is difficult to determine precisely how much radiation is dangerous, radiation of the gonads is known to be harmful and its effect cumulative. Radiation mutagenesis lacks a threshold and all such exposure entails some risk to future generations. With expansion in the use of radioactive materials the genetic "load" will be increased. It should therefore be the aim of all engaged in the use of radiation to keep the exposure of the gonads to a minimum.

One table.

The Pathogenesis of the Hemorrhagic State in Radiation Sickness: A Review. A. C. Upton. Blood 10: 1156-1163, November 1955.

The pathogenesis of the bleeding in acute radiation injury is still not entirely clear. The major etiologic factors postulated are (1) thrombocytopenia, (2) capillary fragility, and (3) clotting defects unrelated to platelets.

The author reviews the literature and reaches the following conclusions:

"The hemorrhagic diathesis produced by whole-body irradiation is an important aspect of acute radiation sickness but varies in severity with species and dose. The pathogenesis of the bleeding is complex; disturbances of nearly all known major hemostatic mechanisms have been reported; however, the most important single etiologic factor appears to be thrombocytopenia, hemorrhage being prevented or arrested by transfusion of intact platelets. The precise role, or roles, of the platelet in this process are unknown. Likewise the nature of the vascular defect permitting escape of the erythrocytes and the mechanism of the various disturbances of clotting which contribute to radiation-induced hemorrhage remain to be determined."

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Association of Irradiation with Cancer of the Thyroid in Children and Adolescents. Dwight E. Clark. *J.A.M.A.* 159: 1007-1009, Nov. 5, 1955.

Report is made of the author's experiences in 13 cases of carcinoma of the thyroid in children under fifteen years of age. All 13 patients in the series had received previous irradiation to the head, neck, or upper chest for benign conditions, at ages ranging from two months to six years. Three of the children had had upper chest irradiation for an enlarged thymus, 3 irradiation to the neck for cervical adenitis, 5 to the head and neck for enlarged tonsils or adenoids, and 2 to the anterior chest for bronchitis or pertussis. The time interval from the exposure to radiation to diagnosis of thyroid tumor was three to ten years, with an average just under seven years. None of the children in this series had any history suggesting previous thyroid disease. The radiation dosage was in the 200 to 725 r (air) range, with treatment portals of varying size. There was thought to be nothing characteristic about the histology or mode of spread of the subsequently developing thyroid carcinomas.

Comment is made on the apparent absolute increase in the incidence of carcinoma of the thyroid occurring in children and adolescents during recent years, and the author theorizes that the widespread use of radiotherapy for benign conditions of the head, neck, and upper chest in infants and young children may well be an etiologic factor.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Mycosis Fungoides Followed for Fourteen Years. The Case of Dr. W. B. Cannon. Joseph C. Aub, S. Burt Wolbach, B. J. Kennedy, and Orville T. Bailey. *Arch. Path.* 60: 535-547, November 1955.

Dr. Walter B. Cannon was a pioneer in the use of x-rays in physiologic experimentation. From 1897, when he was a first-year medical student, through 1908, he studied the movements of the gastrointestinal tract in animals by means of a primitive x-ray tube. His exposure to radiation must have been great; his hands were seriously burned repeatedly. In 1908 Dr. Cannon ceased using x-rays for his investigations and went on to other fields of research. Twenty-four years later, in 1932, a biopsy of the skin revealed evidence of mycosis fungoides. With the objectivity so well known to his friends and associates, he suggested that biopsies be made whenever they would provide information on the development of this incompletely understood condition. The material thus obtained over a period of fourteen years and that from the necropsy were carefully prepared for histologic study.

Four neoplastic diseases arose during the last fourteen years of Dr. Cannon's life: basal-cell carcinomas, an epidermoid carcinoma, mycosis fungoides, and leukemia. Etiologic agents can only be postulated, but a predisposing factor may have been the considerable exposure to unfiltered x-radiation suffered during his early investigative work. The very prolonged exposure to radiation resulted in an x-ray dermatitis of the hands, followed by keratosis, and finally, multiple carcinomas. The histology of the dermatitis and the sequences antecedent to malignant change are similar to those described in other early workers with x-ray apparatus. The mycosis fungoides with a leukemic phase was possible, but less certainly, related to this irradiation.

During the fourteen-year course of the mycosis fungoides, many interesting phenomena were manifest:

First, the spontaneous remissions that so often occurred, especially in the early stages of the disease. The skin plaques and itching often disappeared, only to reappear later. *Second*, the slow rise in the white blood count to 32,700, with a concomitant absolute increase in the lymphocytes to a peak of 90 per cent. A gradual remission followed, but it was not until four years later that the differential count approached normal. This increase in the white blood cell count represented a leukemic phase of mycosis fungoides, emphasizing the close relationship of this disease to the lymphomas and leukemias. *Third*, the development of bilateral facial paralysis and deafness. Apparently this was the result of cellular infiltration in the posterior fossa near the internal auditory meatus, which involved the auditory nerve, chorda tympani, and facial nerves. Fortunately this condition responded to irradiation.

Dr. Cannon's scientific interest led to a continuous exploration of new agents which might improve his condition. Ketogenic and low- and high-carbohydrate, fat, or protein diets were employed, without benefit. Neither was a vaccine of *Escherichia coli* cultured from the urine of any aid. Vitamins A and D were found to be helpful and were constantly administered. On three separate occasions x-ray therapy proved to be of palliative value, chiefly in relief of itching. The proper management of x-ray therapy in a patient already suffering from the effects of irradiation presented a considerable challenge.

[Dr. George W. Holmes took the life of Dr. Cannon for the subject of his historical lecture delivered before the Radiological Society of North America in 1952 (*Radiology* 61: 3, 1953). It will be found of interest in connection with the above abstract.—Ed.]

Leukemia in Survivors of Atomic Bombing. William C. Moloney. *New England J. Med.* 253: 88-90, July 21, 1955.

Up to January 1, 1954, 92 verified cases of leukemia had occurred among survivors of the atomic bombings in Hiroshima and Nagasaki. Of 92 cases, 52 were acute or subacute; of 40 chronic cases, 39 were myelogenous and only 1 was lymphatic.

The peak occurrence of leukemia in survivors was probably reached in 1951. There was a marked decline in cases during 1953. These data indicate that in man the leukemogenic dose of a single exposure to atomic radiation is high.

Biologic evidence in survivors points to a much more intense and extensive neutron flux than estimated physically. Neutrons as well as gamma irradiation were probably involved in the leukemogenesis.

Cytologic features in the preclinical stage of chronic myelogenous leukemia included the early appearance of a small percentage of myelocytes and metamyelocytes and a very significant basophilic cytolysis. Separated leukocytes showed extremely low alkaline phosphatase activity, even in the earliest stages of the disease.

Four tables.

SHOZO IBA, M.D.
Downey, Calif.

The Influence of X-Radiation on Mortality Following Thermal Flash Burns: The Site of Tissue Injury as a Factor Determining the Type of Invading Bacteria. J. Douglas Reid, James W. Brooks, William T. Ham, and Everett Idris Evans. *Ann. Surg.* 142: 844-850, November 1955.

In atomic bomb explosions, the distance of a subject

from ground zero determines whether the injury is primarily caused by blast, thermal radiation, or ionizing radiation. In the intermediate zone, as shown by the Hiroshima and Nagasaki disasters, the victims were exposed to both thermal and gamma radiations. In animals previously studied (Brooks *et al.*: Ann. Surg. 136: 533, 1952. Abst. in Radiology 61: 158, 1953) it was found that an induced burn complicated by total-body x-irradiation resulted in a mortality rate markedly higher than occurred with a burn alone and that the deaths were related to a beta hemolytic streptococcus septicemia.

With this background, the authors attempted to determine the mechanism underlying the mortality of subjects in the intermediate zone in atomic bomb explosions by simulating comparable thermal and ionizing radiation injuries in experimental dogs. Twenty animals received flash burns only, 20 received roentgen irradiation only, and 20 received both flash burns and ionizing radiation. In each dog, deep second-degree burns were effected to an area equaling 20 per cent of the total skin surface. X-radiation was delivered at 100 r to each side of the animal through a whole-body field. So far as possible, all other factors were kept constant. Periodic white blood cell counts, blood cultures, and wound cultures were subsequently taken.

In the dogs that received 20 per cent flash burns alone, a peak leukocytosis occurred in ten days, which corresponded closely to the peak incidence of positive blood cultures in this group. Wound cultures yielded micrococci and/or streptococci. Alpha hemolytic or gamma streptococci were identified from nearly every burn and the incidence of beta hemolytic streptococci was relatively high (23.8 per cent of burn cultures). Twenty-four per cent of the blood cultures revealed a transient bacteremia with organisms of low virulence similar to those isolated from the burns, but beta hemolytic streptococcus was identified in only one instance from an animal that subsequently died.

The dogs that received flash burns plus roentgen radiation demonstrated a transient rise in the white blood cell count followed by leukopenia corresponding to the peak incidence of positive blood cultures. Wound cultures demonstrated predominantly micrococci, gamma streptococci, and beta hemolytic streptococci. The latter were present in 53 per cent of the wound cultures. Twenty-one per cent of the blood cultures yielded a similar bacterial flora, and in most instances more than one type of micro-organism was isolated. In this group 32 per cent disclosed beta hemolytic streptococci in positive cultures. The fatality rate was 25 per cent.

In the group of dogs that received only 100 r total-body radiation, 140 blood specimens were taken and only 2 of the cultures were positive, showing micrococci in each instance.

The blood cultures in the burn-radiation group rarely revealed gram-negative bacteria. This the authors attribute to lack of sufficient radiation to damage intestinal mucosa, so that the portal of entry for enterobacteria was eliminated. The bacteremia was attributed entirely to tissue damage due to burns, a view which is supported by the similarity of bacterial flora in the burn wounds and in the blood cultures. It is concluded that damage to the immune mechanism by sublethal roentgen radiation influences the type of micro-organism that gains entrance to the blood stream. With a depressed body-defense mechanism, more viru-

lent bacteria are permitted to enter from the wound and produce fatal septicemia.

Two graphs; 2 tables. JOHN W. WILSON, M.D.
University of Texas, Dallas

Considerations of the Limits of Radiation Dosage from Thorotrast. J. Rundo. Brit. J. Radiol. 28: 615-619, November 1955.

A number of serious sequelae attributable to the use of Thorotrast have been reported, in the form of malignant tumors or blood disorders. While this substance gives excellent results in many types of radiography as a contrast material, its deleterious effects must be seriously considered. Thorium dioxide is deposited throughout the reticulo-endothelial system. The amounts normally used have been up to 75 ml. containing 15 gm. of thorium, or the equivalent of 3 to 4 μ gm. of radium, as far as alpha radiation is concerned. Skeletal deposits of as little as 5 μ gm. of radium are undoubtedly carcinogenic. Following the use of Thorotrast, the shortest latent period for the induction of malignant tumors appears to be 3.2 years and for the development of blood disorder six years.

In calculating the possible limits of Thorotrast dosage, one must recognize the significance of the initial isotopic composition, since the extremes correspond to Thorotrast containing isotopically pure Th^{232} and Th^{233} in equilibrium with Th^{232} . To determine the energy emitted from thorium initially isotopically pure or from thorium in equilibrium with radiothorium, both the disintegration rates and energies of the particles emitted must be taken into account. An equation for the behavior of the activity of each member of the decay series multiplied by the appropriate energy is developed. The resulting equations are summed into one, which can then be integrated with respect to time. The equations for determining these data are given. Charts depicting cumulative alpha and beta particle emissions from preparations of Thorotrast as a function of time show that the maximum alpha particle emission is nearly three times the lower limit and the corresponding ratio for the beta particle energy emission is 2.25 after six years; after ten years the ratios are 1.73 and 1.50. Allowance for self-absorption of the alpha particles increases the disparity between the two limits.

It is concluded that calculation of the cumulative dosage *in vivo* is uncertain unless the exact composition of Thorotrast relative to its radiothorium content at the time of injection is ascertained. Variables and other approximations (such as the assumed distribution of the radioactive material in the reticulo-endothelial organs, the fractions of decay products washed out of these organs, and the concentration of the thorium per gram of tissue) make the interpretation of clinical damage relative to dose-time relations extremely difficult. Careful assays of liver and spleen biopsies to determine the thorium-radiothorium ratio might yield a more valid and less complex interpretation of the clinical damage as it relates to dose.

Three tables; 6 charts. JOHN W. WILSON, M.D.
University of Texas, Dallas

The Use of Image Tubes and Amateur Photographic Equipment to Reduce Exposure to Radiation at Fluoroscopy. W. Edward Chamberlain. Gastroenterology 29: 549-551, October 1955.

The author mentions and briefly describes the method

by which an "image tube" converts a fluoroscopic image into an electronic image. This conversion results in a marked increase in brightness of the fluoroscopic image and allows one to obtain motion pictures with relative ease. Under ordinary fluoroscopic procedures, the radiologist must study a very dim shadow outline of the gastrointestinal tract. His time of examination is also limited, and occasionally he cannot safely re-examine one area to his satisfaction because of the excessive exposure to radiation.

Cinefluorography is of value in that it enables one to study a "bright" image of the gastrointestinal tract and to study it repeatedly without additional exposure to the patient or the examiners. This should be of great assistance in the study of the physiology of the gastrointestinal tract. The author also feels that cinefluorography may bring us a workable method of gastric cancer case-finding.

One drawing.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Investigations of Biological Protection Against Radiation. XI. Do Amines Afford Protection Against Radiation? H. Langendorff and R. Koch. *Strahlentherapie* 98: 245-254, October 1955. (In German)

Several amines—ethanolamine, ethylamine, methylamine, tyramine, oxytyramine, *l*-arterenol histamine, tryptamine and β -aminoethylisothiuronium—were examined as to their protective effect against radiation. The experiments were carried out on rats and mice receiving radiation doses of about 500 r. The authors did not find any protective effects similar to those previously described for cysteine. Only tryptamine produced a slightly increased resistance to radiation in the animal experiments, the effect being similar to effects obtained with cysteine and cysteamine.

The authors seek to explain the effect of tryptamine on the basis of inhibition of tissue respiration, especially in brain tissue; this may produce a hypoxemia and hypoxia which could produce a protective effect.

Three graphs; 3 tables.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

ACTH in Radiotherapy. A Clinical Trial. K. Sicher. *Brit. J. Radiol.* 28: 620-622, November 1955.

On the basis of a small-scale clinical experiment, the author believes that ACTH has no significant effect on radiation sickness or hematologic changes during x-ray therapy. Twelve patients with advanced pelvic carcinoma undergoing radiotherapy were selected: 6 of these received ACTH, 10 mg. three times daily, while the other 6 constituted a control group. Symptoms of radiation sickness occurred in both groups with equal frequency.

The only significant hematological change in the two groups was in the eosinophil count, which showed a rise about midway in the treatment course in the ACTH-treated group, reaching a higher level than in the control group.

Seven graphs; 1 table. A. R. BENNETT, M.D.
Mt. Sinai Hospital, Cleveland

Experimental Bacteremia in Normal and Irradiated Rats. J. W. Hollingsworth and Paul B. Beeson. *Yale J. Biol. & Med.* 28: 56-62, September 1955.

A common finding in animals which have suffered severe radiation injury is invasion of the blood stream

by bacilli normally found in the intestinal tract. The authors report an experiment having a bearing on this subject. The test method consisted of intravenous injection of a suspension of *E. coli* in two groups of rats. One group of animals received a dose of 800 r total-body exposure three days preceding the test. This was sufficient to reduce the total arterial blood leukocyte count to less than 150 per cubic millimeter on the day of the study. In both groups of animals the main mass of injected organisms disappeared within thirty minutes. There was, however, a consistent and statistically significant difference in the number of bacteria remaining in the circulation, irradiated animals having the larger numbers. Also there appeared to be less tendency to further reduction during the succeeding ninety minutes in the irradiated animals.

It seemed conceivable that these experiments had imposed their maximum load on the mechanism which removes micro-organisms from the circulating blood and that the different level of bacteremia in normal and irradiated animals was due to exhaustion of the clearing mechanism in the latter group. To test this possibility, a second intravenous injection of bacterial culture was carried out. In 6 rats subjected to the usual dose of radiation, the usual severe leukopenia developed at the end of three days. Four hours after the first injection, a second injection was made. Interpretation of the results of this experiment revealed that the clearing mechanism still functions efficiently at this stage of radiation injury.

The low-grade bacteremia which persists for forty-eight hours or more after intravenous injection of a culture of living organisms may be due to (1) infection of some tissue or tissues, multiplication of bacteria, and their discharge into the circulation, or (2) to the arrest of some of the organisms in certain tissues to be released or carried to other organs at a later time, where they are finally destroyed. This would appear to be the probable explanation of the findings in normal animals.

The most obvious point to be emphasized is that in the irradiated leukopenic animals there appears to be no major impairment of the reticular endothelial function, i.e., removal of living bacteria promptly from the circulating blood.

Probable causes of the quantitatively greater residual bacteremia in the irradiated animals are: (1) greater susceptibility of the irradiated tissues to bacterial infection; (2) diminished ability to destroy organisms wherever they are originally arrested.

The conclusion is drawn that the principal defect lies not so much in an ability of the fixed phagocytes to extract bacteria from the blood stream as in a lessened capacity to destroy bacteria wherever they are arrested. As a consequence, in irradiated animals there is greater opportunity for re-entry of the bacteria into the circulation after temporary sequestration in various locations.

One graph; 2 tables. SAIM GOKHAN, M.D.
Mercy Hospital, Pittsburgh

The Problem of Legislative Regulation of Radiation Protection. Herbert Graf. *Röntgen Blätter* 8: 354-368, November 1955. (In German)

In West Germany, radiation protection is not regulated by law. Recommendations have been issued periodically by a committee of experts and, although acceptance is voluntary, enforcement is encouraged by judiciary penalization in civil suits when the court is

convinced that current recommendations have not been followed. In East Germany similar, if not identical, regulations have been made binding by decree dated Nov. 25, 1954.

The situation in other countries is also discussed, ranging from the strict legislation of New Zealand, Sweden, and Italy, to the partial (isotopes) coverage in Great Britain, the coming regulations in Canada [as of

1954], and the diversity of conditions from state to state in the United States.

The author attempts to present the problem impartially and to let the reader make his own decision as to what is preferable. He appears, however, to favor a voluntary system, provided uniformity is assured.

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